March 10, 1925.

1,529,034

E. L. PAGE

METHOD OF FORMING BEARINGS FROM CAST METAL

Filed Oct. 10, 1919

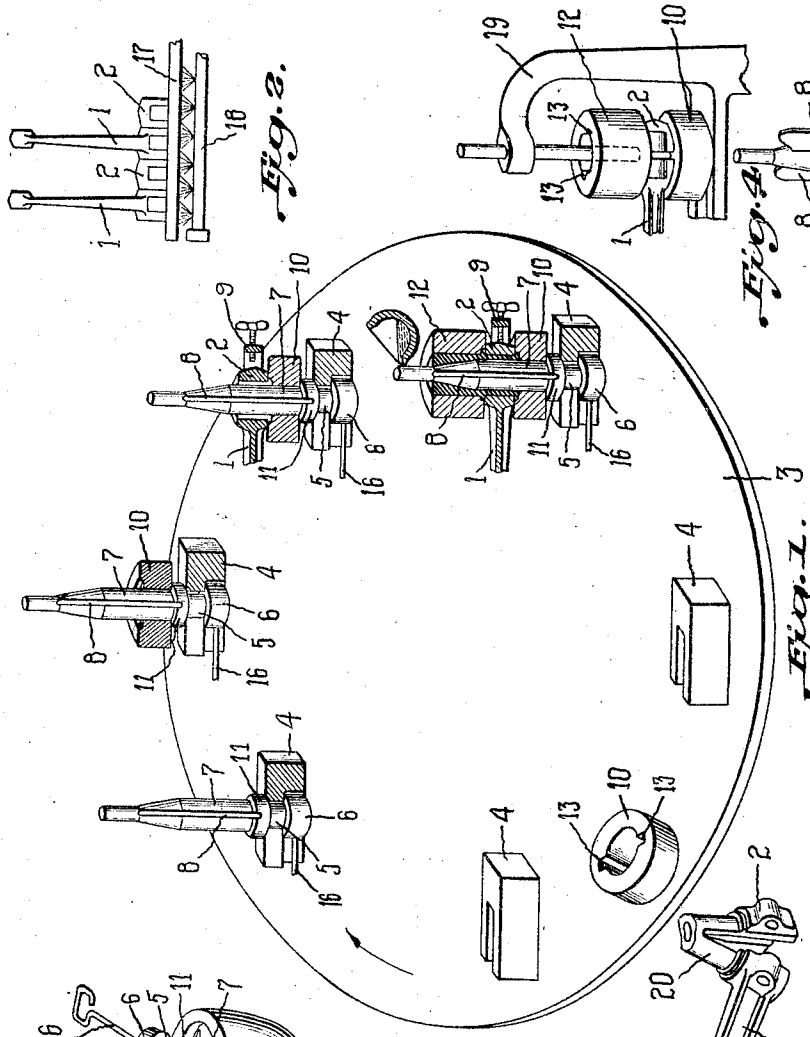


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

WITNESS.

INVENTOR

Emmett L. Page

BY

Blackmore, Spencer & Flint

ATTORNEYS

Patented Mar. 10, 1925. 1,529,034

UNITED STATES PATENT OFFICE.

EMMETT L. PAGE, OF PONTIAC, MICHIGAN, ASSIGNOR TO GENERAL MOTORS CORPORATION, OF DETROIT, MICHIGAN, A CORPORATION OF DELAWARE.

METHOD OF FORMING BEARINGS FROM CAST METAL.

Application filed October 10, 1919. Serial No. 329,763.

To all whom it may concern:

Be it known that I, EMMETT L. PAGE, a citizen of the United States, and a resident of Pontiac, county of Oakland, and State of Michigan, have invented certain new and useful Improvements in Methods of Forming Bearings from Cast Metal, of which the following is a full, clear, concise, and exact description, such as will enable others skilled in the art to which the invention relates to make and use the same, reference being made therein to the accompanying drawings, which form a part of this specification.

My invention relates to the art of casting metals, alloys, etc., which fuse at a comparatively low temperature, in or by the use of metal molds; and particularly to the art of casting bearings in place within seats or openings provided for their reception and within which they remain until worn out, or throughout their entire life or period of usefulness; such, for example, as is the case in the bearings of connecting rods used in internal combustion and similar engines, in pumps, compressors, and similar devices. My invention is not, however, limited to the production of bearings; and the method wherein the same consists regarded in its broader aspects may be used in the production of elements other than bearings, and in fact for the production of articles generally from easily fusible metals or alloys such as may be and are commonly cast in metal molds.

The object of my invention is to provide an improved process or method of casting articles in metal molds coming within the purview of the general art above mentioned, and to provide in particular an improved method applicable to the production or formation of bearings for connecting rods, the same being located permanently within openings provided in the rods for their reception; said method or process being one whereby a better and a more uniform product or bearing is secured, wherein the number of bearings which may be produced in a given time is greatly increased, and wherein the cost of the individual bearings as well also as of the apparatus used in their production is materially reduced.

The drawing accompanying and forming a part of this specification illustrates in a conventional and schematic manner apparatus suitable for performing my method or process, as well also as the manner in which a bearing of a connecting rod may be formed in accordance with the method wherein my invention consists.

In the drawing:

Figure 1 is a view showing in a conventional manner a moving structure carrying various devices used in performing the process wherein my invention consists.

Figure 2 is a view showing a preheating device used in my process.

Figure 3 is a view showing another preheating device for heating mandrels used in my process.

Figure 4 is a view showing an arbor press used, when necessary, in performing my process.

Figures 5 and 6 are views illustrating certain finishing steps performed upon connecting rod bearings produced in accordance with my improved process.

Referring to the drawing, and first to Figures 1 and 2 thereof, the reference numeral 1 designates a connecting rod and 2 a cap secured to the free end thereof by suitable bolts in the finished rod, the end of said rod and said cap having semicylindrical recesses which register with one another and form an opening within which the bearing as a whole is formed, and within which it remains until it is worn out; the bearing being in two parts which are formed simultaneously, one part being in the recess or seat in the end of the rod proper and the other in the recess or seat in the cap portion thereof, both parts of the bearing being firmly anchored in their respective seats so that they will not become separated from the rod parts when the bearing is in use. The formation of the bearing in two parts one in each of the two rod parts or members between which spacing shims may be placed obviously provides a bearing which may be easily tightened as it becomes worn, although my invention is applicable, without variation as to the distinguishing features thereof, to the formation of solid bearings within openings in integral or one-piece rods; the bearings being in all cases formed in situ within the openings provided for their reception, in which position they remain through their entire life and until worn out.

The reference numerals 3 designates in a

purely conventional manner a rotating table, traveling conveyor, or equivalent movable structure or device capable of supporting a plurality of brackets 4 or supports spaced apart from one another and which, because of the movement of the structure or device whereby they are carried, are moved in succession in the direction indicated by the arrow past stations at which one or another of the acts which collectively constitute my process are performed.

The blocks 4 are slotted to receive the necks 5 and heads 6 of mandrels 7 of cylindrical form to conform with and shape the wearing surfaces of the bearings to be formed, and which mandrels are provided with oppositely located projecting spacing plates 8 which lie between the adjacent surfaces of the end of the rod proper 1 and its cap 2 when the said parts are assembled and held together as by clamps 9 whereby the parts of the rod and the mandrel are clamped together. The rod when assembled with the mandrel rests upon and is supported by a lower mold member or ring 10 which fits the mandrel tightly and rests upon and is supported by a collar 11 of the mandrel; and a second ring or mold section 12 surrounds the mandrel and rests upon the upper side of the connecting rod, and is spaced apart from the mandrel to thereby provide a riser which is formed when molten metal is poured into the mold.

Both the mold sections or rings are provided with oppositely disposed slots 13 which engage and fit about the outer edges of the spacing plates 8 when the mold parts and the connecting rod are assembled, preparatory to the formation of a bearing, whereby the said parts are kept in proper positions relative to the mandrel and a mold structure the parts of which are not likely to be displaced during the casting or bearing forming process is provided.

The mold structure per se above briefly described forms no part of the invention to which this present application relates; the same being disclosed in detail and claimed in my application for patent for molding device for forming bearings, etc., filed upon May 20th, 1919, Serial Number 298,520, the subject matter of which is the mold above referred to, and which mold is used in explaining the method or process to which this present application relates. I wish to expressly state, however, that the method to which this present application relates is in no way limited to the use of molds having the particular structural features illustrated, and that the same may be performed by the use of molds the construction of which varies materially from that illustrated in the drawing.

In performing my process each separate mandrel 7 is first heated to a temperature sufficiently high to avoid the chilling of the molten metal from which the bearing is formed to such an extent as to interfere with the formation of the bearing as the metal is poured into a mold chamber the lower portion of which is in the vicinity of a connecting rod and provides the bearing proper, while the upper portion thereof forms a riser; such heating being preferably accomplished by the use of a bath of molten metal contained within a pot 14 or other receptacle, see Figure 3, which receptacle is heated in any way as by means of a gas burner 15 and within which bath the mandrels are immersed.

After the mandrel has been sufficiently heated it is removed from the heating bath by a handle 16, and the same is slid into the slot provided for its reception in the bracket 4 which is at that time adjacent the heating bath.

The mandrel in question is next advanced by the movement of the carrier 3, see Figure 1, into a position adjacent a second station, and the lower mold section or ring 10 is placed upon the mandrel and permitted to rest upon the collar 11; the spacing plates at the sides of the mandrel lying within the slots 13 and the lower mold member helping to hold the parts in proper position relative to one another. The lower ring member fits tightly about the lower end of the mandrel so as to prevent the flow of molten metal between the mandrel and ring during the casting operation.

The mandrel with the lower mold section 10 in place thereupon is next advanced by the continued movement of the carrier 3 into a position adjacent a third station; at which the connecting rod 1 and cap 2 thereof which have been previously heated to a temperature sufficiently high to avoid the chilling of the molten metal during the casting operation by the device shown in Figure 2, or an equivalent device, are placed upon said lower section or ring and are clamped in place by the clamp 9, the spacing plates 8 of the mandrel being held in place between and adjacent surface of the rod and its cap by the clamp. The parts of the rod are thus held in proper position relative to the mandrel, and in a position such that the bearing formed between the mandrel and the parts of the rod will be concentric with the opening provided by the registering recesses which receive the molten metal. The heating of the rod parts may be done in any way such, for example, as by the use of a plate 17 which is heated by a burner 18, as shown in Figure 2.

The carrier next moves the bracket in question and the mandrel and lower mold member 10, with the connecting rod resting thereupon, to another station at which the upper mold member 12 is placed upon the

mandrel; the slots 13 therein engaging the outer edges of the spacing plates 8 of the mandrel to thereby steady the said upper section as it rests upon the upper side of the connecting rod. This uppermost mold section is larger than the portion of the mandrel over which it fits, to thereby provide a riser when molten metal is poured into the mold.

After the mandrel, the two mold sections, and the connecting rod have been assembled in the manner above explained, the mold as a whole is in condition for pouring; and molten metal is now poured into the mold chamber provided by the parts of the connecting rod and by the upper mold member 12, which metal runs down into and fills the space between the connecting rod and the mandrel within which the bearing proper is formed. The pouring operation is continued until the riser is full or substantially full, and as the mold cools the metal within the riser, which remains fluid longer than the metal between the connecting rod parts, settles, and thereby prevents the formation of blow holes or internal cavities in the bearing proper, due to the contraction of the metal which forms the bearing.

After the pouring of the molten metal into the mold, and after sufficient time has been allowed for the same to set and harden to an extent sufficient to retain its form, the connecting rod and mold parts are disassembled, by the aid of a suitable arbor press 19 as shown in Figure 4 should the use of such a device be necessary, the mandrel being forced downward through the mold parts. The bearing within the connecting rod parts may then be readily separated from the lower mold section, and the upper mold section may be easily removed from the riser. The riser 20 is next removed from the bearing parts in any way; as by breaking the connecting rod proper and cap part, as indicated in Figure 5, and removing the portions of the riser extending from each of the two parts of the bearing by means of a metal saw 21 as shown in Figure 6. The two parts of the connecting rod are next clamped together, suitable shims being interposed between the meeting surfaces of the parts, and the bearing reamed or otherwise finished to provide the finished bearing.

It will be appreciated from the foregoing that the process wherein my invention consists is continuous, that is, that the mandrel supporting brackets are carried by the traveling carrier past a plurality of stations and are supplied with a heated mandrel at one station, and with the mold sections and the parts of the connecting rod at other stations, the pouring of the molten metal into the mold chamber of successive molds is done in succession as the assembled molds and connecting rods reach other stations, and the mandrels with their assembled mold sections and connecting rods and the formed bearing with its riser are removed from the brackets in succession at the last station; after which the parts are disassembled and the bearing finished as above explained. I wish, however, to expressly state that each separate step or operation hereinbefore enumerated need not be done at a separate station; but that on the contrary two or more of the assembling, pouring, or disassembling steps may be performed at a single station, so long as the acts or operation referred to are performed in the order pointed out.

In carrying out the process above outlined the upper and lower mold sections are assembled with heated mandrels before said mold sections have parted with the heat which they acquired from the molten metal during the casting operation, said sections being of such mass that they lose heat slowly after they have become heated; from which it follows that the mold sections themselves do not have to be heated prior to the assembling thereof with the mandrels after the process has been started and is under way. The mandrels, however, are each heated to a substantially uniform temperature as above explained before being assembled with the mold sections, as it is obviously more important to have uniformity of temperature in the mandrels in order to secure uniformity in the bearings which are formed in direct contact therewith, than in the upper and lower mold sections. As the mandrels move past the assembling stations, due to the movements of the carrier, they obviously part with some of their heat to the upper and lower mold sections and, as explained, said sections are further heated by the molten metal which is poured into the mold; from which it follows that the upper and lower mold sections do not have to be heated, but, on the contrary remain in a heated condition as long as the process is in operation; it being of course obvious that more mandrels than pairs of mold sections will be employed in the working of the process in order to provide a supply of heated mandrels.

It will be appreciated that the portion of each mold structure which is in immediate contact with the bearing formed therein in the performance of my process, that is, the mandrel 7 and the projecting spacing plates 8 which, in the form of mold illustrated, form a part of the mandrel, is heated by the use of the molten metal bath to a temperature closely approximating that of the bearing forming metal which is poured into the successive molds; as the metal used in the bath will ordinarily be one which will be in the liquid form at temperatures corresponding, approximately, with the tem-

perature of the molten metal from which the bearings are formed; it therefore follows that detrimental chilling of the molten metal as it is poured into the mold is prevented, and that the molten metal after it enters the portions of the mold chambers within which the bearings are formed will in each case be in contact with a metal portion of the mold the temperature of which is near that of the bearing metal itself, thus resulting in uniformity in the bearings produced in successive molds; and that the cooling of the metal within each mold will be progressive, the portion thereof in immediate contact with the mandrel cooling the slowest and perhaps remaining in the liquid form after portions of the bearing remote from the wearing surface thereof, which is formed in contact with the mandrel, have become solid. This fact, in connection with the presence of the metal within the riser which remains liquid longer than the metal which forms the bearings, because of its comparatively large mass, results in bearings of uniform quality and the metal of which, particularly at the wearing surfaces thereof, is free from blow holes and is smooth and of uniform texture and density throughout.

The above at least is my understanding as to what occurs within the molds during the formation of the bearings; although it is not asserted that other phenomena may not enter into and be concerned with the ultimate physical process involved in the making of bearings or equivalent articles in accordance with the method herein explained, nor that the ultimate action of the various elements, features and steps entering into the method may not be accounted for and explained by other theories.

Having thus described the method or process wherein my invention consists and disclosed an apparatus or mechanism whereby the same may be performed, I claim and desire to secure by Letters Patent:

1. The method of forming a bearing for a connecting rod within an opening provided for receiving the same and for retaining it throughout its life which consists in immersing a mandrel adapted to provide the wearing surface of the bearing in a bath of molten metal having a melting point corresponding, approximately, with that of the metal from which the bearing is to be formed, to thereby heat the mandrel to a temperature corresponding, approximately, with the temperature of the molten metal from which the bearing is to be formed; heating the connecting rod which is to be provided with a bearing to a temperature sufficiently high to avoid detrimental chilling of the molten metal from which the bearing is to be formed; assembling said mandrel and connecting rod with the two rings surrounding said mandrel and between which sand connecting rod lies, and the upper of which rings is larger than said mandrel to thereby provide a riser above the bearing being formed; pouring molten bearing forming metal into the space between the upper of said rings and said mandrel; disassembling said rings and mandrel and said connecting rod; and finishing the resulting bearing.

2. The method of forming a bearing for a connecting rod within an opening provided for receiving the same and for retaining it throughout its life which consists in immersing a mandrel adapted to provide the wearing surface of the bearing in a bath of molten metal having a melting point corresponding, approximately, with that of the metal from which the bearing is to be formed, to thereby heat the mandrel to a temperature corresponding, approximately, with the temperature of the molten metal from which the bearing is to be formed; heating the connecting rod which is to be provided with a bearing to a temperature sufficiently high to avoid detrimental chilling of the molten metal from which the bearing is to be formed; assembling said mandrel and connecting rod with two mold sections which, in connection with the mandrel and the rod, provide an annular space within which the bearing is formed and a space for a riser extending above the bearing; pouring molten bearing forming metal into the space provided for the riser and into the annular bearing providing space beneath the riser space; disassembling said connecting rod, said mandrel, and said mold sections; and using said mold sections in the performance of a second bearing forming operation while they are in a heated condition.

3. The method of forming a bearing for a connecting rod within an opening provided for retaining the bearing throughout the life thereof which consists in immersing a mandrel adapted to provide the wearing surface of the bearing in a bath of molten metal having a melting point corresponding, approximately, with that of the metal from which the bearing is to be formed, to thereby heat the mandrel to a temperature corresponding, approximately, with the temperature of the molten metal from which the bearing is to be formed; heating the connecting rod which is to be provided with a bearing to a temperature sufficiently high to avoid detrimental chilling of the molten metal from which the bearing is to be formed; assembling said mandrel and the connecting rod with two mold sections of such form as to provide in connection with the connecting rod a mold chamber made up of a lower annular space corresponding with

the bearing to be formed, and a riser extending above said bearing; pouring molten bearing forming metal into the mold chamber aforesaid; disassembling said connecting rod, said mandrel, and said mold sections; and using said mold sections in the formation of a second bearing before they have lost the heat imparted to them in the performance of a previous bearing forming operation.

4. The method of forming bearings for connecting rods within openings provided in the rods and within which the bearings remain throughout their life which consists in continually and in succession immersing mandrels adapted to provide the wearing surfaces of the bearings in a bath of molten metal having a melting point corresponding, approximately, with that of the metal from which the bearings are to be formed, to thereby heat the mandrels to temperatures corresponding, approximately, with the temperature of the molten metal from which the bearings are to be formed; continually and in succession heating the connecting rods which are to be provided with bearings to a temperature sufficiently high to avoid detrimental chilling of the molten metal from which the bearings are to be formed; assembling the mandrels one after another each with a connecting rod, and with two mold sections of such a form as to provide in each instance and in connection with the connecting rod a mold chamber made up of a lower annular space corresponding with the bearing to be formed, and a riser extending above said bearing; pouring proper quantities of molten bearing forming metal into each of the mold chambers aforesaid in succession; disassembling the connecting rods, the mandrels, and the mold sections after the formation of each separate bearing as aforesaid; and using said mold sections immediately and before they have had time to cool with other heated mandrels in the formation of additional bearings in a continuous and unbroken cycle.

5. The method of forming a bearing within an opening provided for retaining the same throughout the life thereof which consists in immersing a mandrel adapted to provide the wearing surface of the bearing in a bath of molten metal having a melting point corresponding, approximately, with that of the metal from which the bearing is to be formed, to thereby heat the mandrel to a temperature corresponding, approximately, with the temperature of the molten metal from which the bearing is to be formed; heating the member which is to be provided with a bearing to a temperature sufficiently high to avoid detrimental chilling of the molten metal from which the bearing is to be formed; assembling said mandrel and member with two mold sections of such form as to provide in connection with the member a mold chamber made up of a lower annular space corresponding with the bearing to be formed, and a riser extending above said bearing; pouring molten bearing forming metal into said mold chamber; disassembling the parts aforesaid; and using said mold sections in the formation of a second bearing before they have lost the heat imparted to them in the performance of a previous bearing forming operation.

6. The method of forming a hollow cast metal article within and anchored in place in an opening provided in a member which consists in immersing a mandrel adapted to lie within said opening in a bath of molten metal having a melting point corresponding, approximately, with that of the metal from which the article is to be formed, to thereby heat the mandrel to a temperature corresponding, approximately, with the temperature of the molten metal from which the article is to be formed; heating the member to which the article produced is to be anchored to a temperature sufficiently high to avoid detrimental chilling of the molten metal from which the article is to be formed; assembling said mandrel and member with two metal mold sections of such form as to provide a lower space surrounding said mandrel and corresponding in form with the article to be formed, and a riser extending above said article forming space; pouring molten metal into the said mold chamber; disassembling the parts aforesaid; and using the said mold sections in the formation of a second article before they have lost the heat imparted to them in performance of a previous article forming operation.

7. The method of forming a cast metal article anchored to a member to which it is to remain attached which consists in immersing a suitable mold member in a bath of molten metal having a melting point corresponding, approximately, with that of the metal from which the article is to be formed, to thereby heat said mold member to a temperature corresponding, approximately, with the temperature of the molten metal from which the article in question is to be formed; heating the member to which the cast metal article is to be anchored to a temperature sufficiently high to avoid detrimental chilling of the molten metal in question; assembling said last mentioned member and said heated mold member with mold sections of such form as to collectively provide a mold chamber made up of a lower space within which the cast metal article produced is to be formed, and a riser space extending above said article space; pouring molten metal into the mold chamber aforesaid; disassembling the several parts hereinbefore mentioned; and using said mold sections in the formation of a second cast metal

article before they have lost the heat imparted to them in the performance of a previous article forming operation.

8. The method of forming a bearing within an opening provided for retaining the same throughout the life thereof which consists in immersing a mandrel adapted to provide the wearing surface of the bearing in a bath of molten metal having a melting point corresponding, approximately, with that of the metal from which the bearing is to be formed, to thereby avoid detrimental chilling of the molten metal from which the bearing is to be formed; assembling the member which is to be provided with a bearing with two mold sections of such form as to provide in connection with the mandrel a mold chamber made up of lower annular space corresponding with the bearing to be formed, and a riser extending above said bearing; pouring molten bearing forming metal into said mold chamber; disassembling the parts aforesaid; and using said mold sections in the formation of a second bearing before they have lost the heat imparted to them in the performance of a previous bearing forming operation.

In testimony whereof I affix my signature.

EMMETT L. PAGE.