M. T. LOTHROP.

PROCESS OF MAKING CONICAL CUPS FOR ROLLER BEARINGS.

APPLICATION FILED JUNE 12, 1918.

1,326,205. Patented Dec. 30, 1919

2 SHEETS—SHEET 1.

Fig. 1.

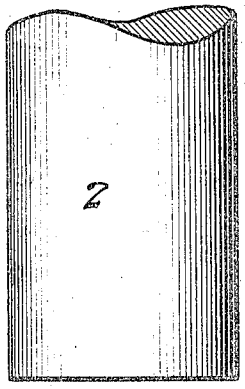



Fig. 2.

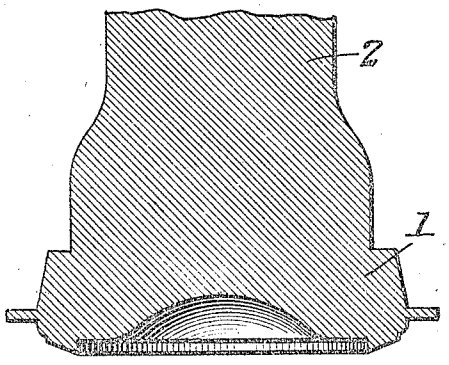



Fig. 3.

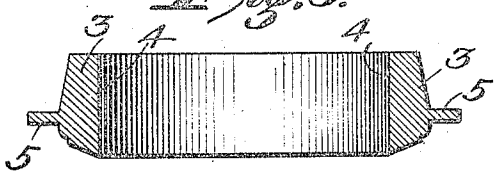



Fig. 4.

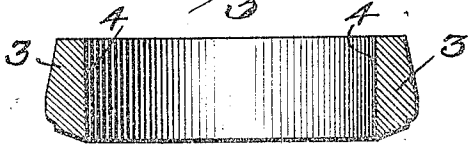



Fig. 5.

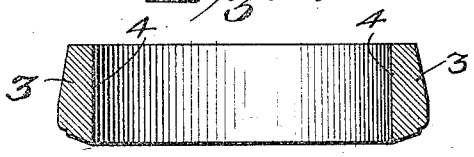



Fig. 6.

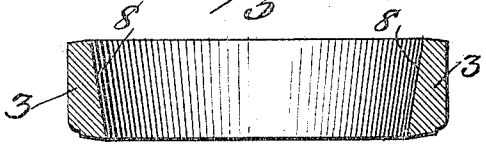



Fig. 7.

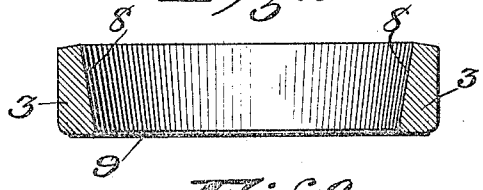



Fig. 8.

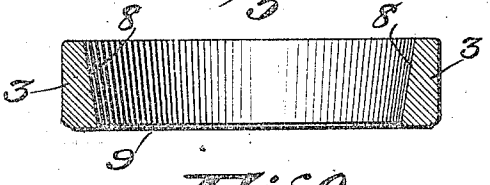
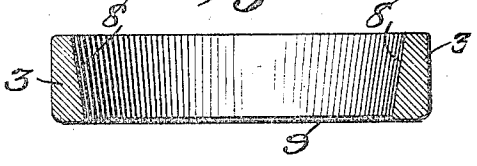



Fig. 9.




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2 SHEETS—SHEET 2.

Fig. 10.

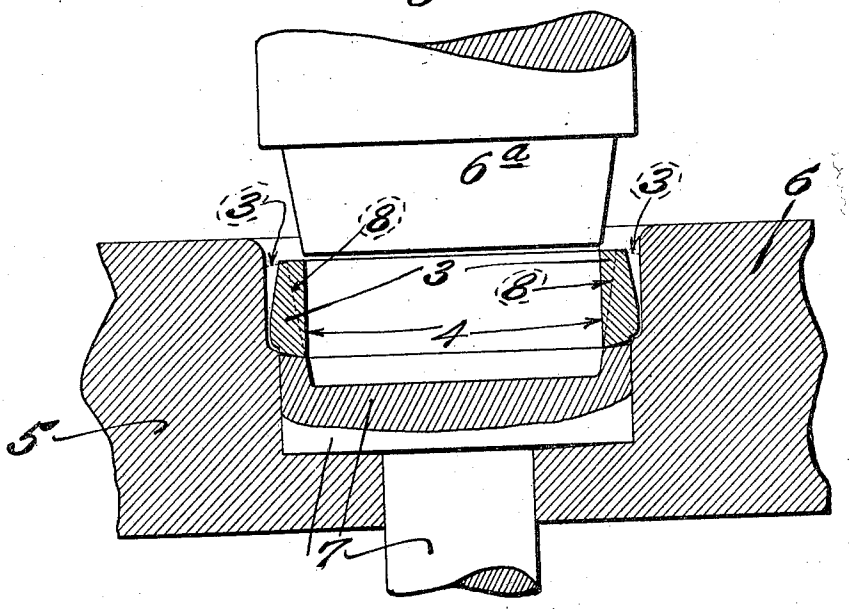
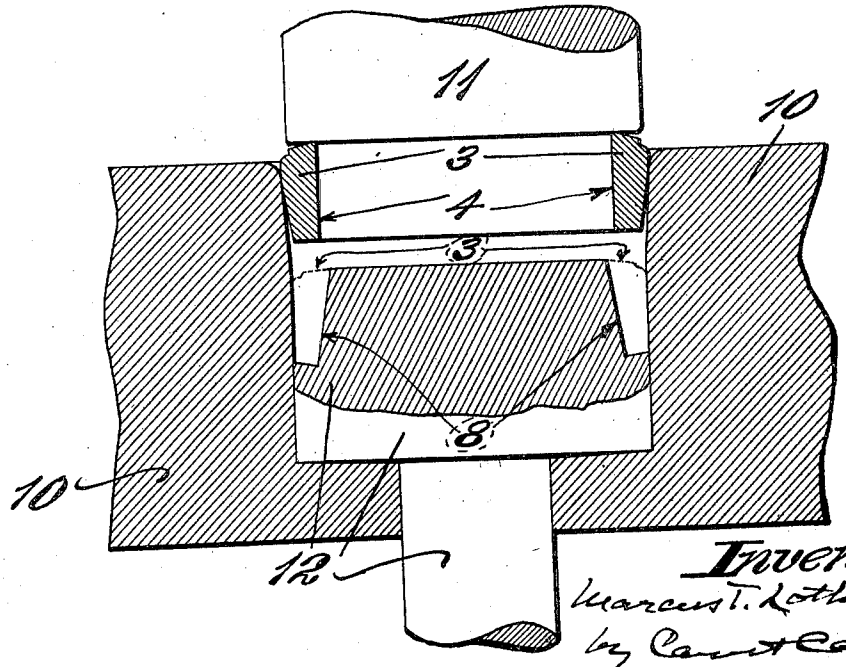



Fig. 11.




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# UNITED STATES PATENT OFFICE.

MARCUS T. LOTHROP, OF CANTON, OHIO, ASSIGNOR TO THE TIMKEN ROLLER BEARING COMPANY, OF CANTON, OHIO, A CORPORATION OF OHIO.

## PROCESS OF MAKING CONICAL CUPS FOR ROLLER-BEARINGS.

1,326,205. Specification of Letters Patent. Patented Dec. 30, 1919.

Application filed June 12, 1918. Serial No. 239,646.

*To all whom it may concern:*

Be it known that I, MARCUS T. LOTHROP, a citizen of the United States, and a resident of the city of Canton, in the county of Stark and State of Ohio, have invented a new and useful Process of Making Conical Cups for Roller-Bearings, of which the following is a specification.

My invention relates to conical cups for roller bearings and has for its principal object to minimize the cost of producing a satisfactory cup. It consists principally in hot-forging a blank to form (either alone or in connection with a punching operation) into a ring of suitable dimensions for making the finished product, reaming out the inner surface of said ring to a substantially cylindrical form, and then coning said inner surface to the desired angle by expansion or contraction of the wall, followed or not by heat treatment and other suitable operations.

In the accompanying drawing wherein like symbols refer to like parts:

Figure 1 is a side view of a round bar constituting the stock from which the bearing cup is formed;

Fig. 2 illustrates the second stage wherein that portion constituting the body of the cup is formed on the lower end of the solid bar stock by a suitable forging operation;

Fig. 3 illustrates the third stage wherein that portion constituting the body of the cup has been removed from the bar stock and pierced to form a ring;

Fig. 4 illustrates the fourth stage wherein the flashing or fin produced as an incident of the forging operation has been trimmed off;

Fig. 5 represents the fifth stage in which the inner wall of the ring has been reamed to form a substantially cylindrical surface;

Fig. 6 represents the sixth stage wherein the inner surface of the ring has been changed from a cylindrical surface to a conical surface by expansion of the wall of the ring;

Fig. 7 illustrates the seventh stage wherein the bottom surface of the ring has been machined and the bottom edge of the hole therein chamfered;

Fig. 8 illustrates the eighth stage wherein the top and outside surfaces of the cup are machined, and the corner formed by these surfaces rounded;

Fig. 9 represents the final stage wherein the bottom, inside and outside surfaces of the cup are finished by grinding;

Fig. 10 is a vertical section showing an apparatus for coning the inner surface of the ring by expansion, and comprising a mandrel (shown in raised position) and a die; and

Fig. 11 is a vertical section showing an apparatus for coning the inner surface of the ring by contraction, and comprising a mandrel, a plunger and a die.

I prefer to start my process with a blank 1 consisting of or cut from a bar 2 or heavy sheet metal. This blank is heated to a suitable temperature for forging and subjected to the action of a forging machine. The subsequent operations are effected while the metal is cold. The purpose of the drop-forging is to compact the metal and shape the blank 1 for the subsequent operations. The initial blank may be an annular punching, in which case the forging operation converts the blank into a ring with a substantially cylindrical bore; but if the initial blank was imperforate, its middle portion is punched out after the forging operation so as to produce a ring 3 with a substantially cylindrical bore 4. In either case, the outer surface of the ring 3 tapers, the bore 4 is cylindrical, the outer edge of the thicker end is beveled, and the outer wall has an annular fin or flashing 5 occasioned by the metal being squeezed out between the die and the hammer, all as illustrated in Fig. 3. The forging is then pickled in a suitable solution and the flashing or fin 5 is removed therefrom by any suitable operation, such, for instance, as shearing, thereby leaving the ring in the condition illustrated in Fig. 4. The inner surface of the ring 3 is then reamed out to make it approximately cylindrical, as illustrated in Fig. 5. The ring 3 in the condition illustrated in Fig. 5 is then placed in a suitable holder or anvil 6 that is equipped with a reciprocatable plunger or mandrel $6^a$ comprising a conical pressure surface, all as illustrated in Fig. 10, wherein the full lines illustrate the initial position of the mandrel and the condition of the ring 3 before expansion, and wherein the dotted lines represent the ring expanded. As the conical mandrel is forced endwise into the ring, it progressively enlarges the hole therein, the inner surface of the ring

conforming accurately to the outer conical surface of the mandrel leaving the ring 3 with a conical bore 8 as illustrated in Fig. 6. The ring is loosened from the holder 6 by a suitable knockout 7. Preferably, the expansion is accomplished in one operation. In some cases this expansion requires more than one operation. The coning is carried forward by degrees until the desired degree of taper is obtained. One effect of this operation of coning the inner surface of the ring is to make the outer surface more nearly cylindrical and to bring the thicker end wall into a position more nearly perpendicular to the axis of the ring, these features being especially advantageous for the economical performance of the subsequent operations.

While the apparatus carrying out my process does not form part of the present invention, sufficient of the apparatus is shown in Fig. 10 to illustrate the operation of converting the cylindrical bore into a conical bore.

When the ring has been expanded so as to cone the cup to the required angle, it is finished in any suitable manner. For instance, the bottom surface of the cup is then machined and the bottom edge of the conical bore therein beveled or chamfered, as at 9, as illustrated in Fig. 7. The outside surface of the cup is then machined and the outside top corner rounded as illustrated in Fig. 8. After the machining operation, the cup may be carbonized and heat treated in any suitable way; but as the thickness of its wall varies, it is desirable to mount the ring on a form on which it fits so as to prevent distortion while undergoing heat treatment. The final operation is finishing the inside, outside and bottom faces of the cup to the required shape and dimensions which may be economically done by grinding, thereby putting the ring in the finished condition illustrated in Fig. 9.

Among the principal advantages of the foregoing process are the fact that it permits the use of an economical material and the fact that it minimizes the need for skilled labor in the manufacture of bearing cups. The preliminary forging operation renders the metal compact and fit for its intended purpose and it produces a wall of such section that the operation of expansion itself prepares the ring for finishing at a minimum cost. The operation of reaming is an accurate operation effected by machine without the need for skilled labor and producing a surface fit for coöperation with the bearing rollers. The expansion of the ring 3 with the cylindrical opening 4 by means of the conical mandrel results in the production of a conical surface 8 fit for coöperation with the bearing rollers and far more accurate than can now be produced except by skilled labor. The operation of machining the surfaces of the cup is likewise expedited by reason of the preparation made therefor in the earlier operations, namely, the forging of the wall of the ring into a cross-sectional size and shape adapted to be converted by the operation of expansion into a size and shape best suited for finishing at the least cost and with the least waste. The grinding operation is done after the cup has been machined and hardened, thus resulting in a cup having accurately finished and highly polished surfaces.

Although I have described the operation on the cylindrically reamed ring as an expanding operation, wherein the inner surface of the ring has been formed into a cone with a base of greater diameter than the diameter of the cylinder, it is feasible to form the cone by contracting its forward end in a contracting die 10, as illustrated in Fig. 11, wherein the full lines show the position of the plunger 11 at the beginning of its stroke and the corresponding position and shape of the ring, while the dotted lines show the position and shape of the ring at the completion of the stroke of the plunger. For this purpose, the reamed cylindrical ring is made with a diameter equal to the diameter of the base of the desired cone. The ring is loosened from the die 10 by a suitable knockout 12.

What I claim as my invention is:

1. The process of making cups for conical roller bearings which consists in forming a ring with a tapering outer surface by forging and punching a metal bar, forming the bore thereof into a cylindrical surface and die-forming said cylindrical surface into a conical surface.

2. The improvement in the process of making cups for conical roller bearings which consists in forging a ring, forming the bore thereof into a cylindrical surface, and converting said cylindrical surface into a conical surface by pressure of the ring axially against a conical surface.

3. The improvement in the process of making cups for conical roller bearings which consists in forging a ring, reaming the bore thereof to form a cylindrical surface, and converting said cylindrical surface into a conical surface by pressure of the ring axially against a conical surface.

4. The improvement in the manufacture of cups for conical roller bearings which consists in reaming a cylindrical hole in a ring with a tapering outer wall, and expanding said ring so as to convert the cylindrical inner surface into a conical surface whose base is at the thinner end of the wall.

5. The process of making cups for conical roller bearings which consists in forging a ring with a tapering outer surface, forming a cylindrical inner surface thereon, and ex-

panding said ring by means of a conical mandrel to convert said cylindrical surface into a conical surface and simultaneously making said outer surface approximate the surface of the finished cup.

6. The process of making cups for conical roller bearings which consists in forging a ring with a tapering outer surface, reaming a cylindrical inner surface thereon concentric with said outer surface, and expanding said ring by means of a conical mandrel to convert said cylindrical surface into a conical surface and simultaneously making said outer surface more nearly cylindrical.

7. The process of making cups for conical roller bearings which consists in forging a ring with a cylindrical bore and a tapering wall and with the outer edge of the thick end of the wall beveled, reaming said bore cylindrically, expanding said ring by means of a conical mandrel to convert said cylindrical surface into a conical surface and simultaneously making said outer surface approximate the surface of the finished cup.

8. The process of making cups for conical roller bearings which consists in forging a ring with a tapering outer wall, reaming a cylindrical hole in said ring, operating on said ring with a conical mandrel to convert the cylindrical inner surface thereof into a conical surface, and finishing with suitable heat treatment and machining.

9. The process of making cups for conical roller bearings which consists in forging a ring with a tapering outer wall, reaming a cylindrical bore in said ring, power shaping said ring to convert the cylindrical bore into a conical bore and finishing by suitable heat treatment followed by grinding.

10. The process of making cups for conical roller bearings and the like which consists in hot-forging a blank into a conical shape with its outer surface of substantially the same taper as desired for the inner surface of the finished cup, reaming a cylindrical surface for the bore of said blank concentric with the outer conical surface thereof and then changing the cylindrical surface into a conical surface of the desired taper by stretching the metal circumferentially over a conical mandrel of said desired taper.

Signed at Canton, Ohio, this 3rd day of June, 1918.

MARCUS T. LOTHROP.