No. 698,707. Patented Apr. 29, 1902.

A. JOHNSTON.

METHOD OF MAKING HOLLOW BALLS.

(Application filed Sept. 20, 1901.)

(No Model.)

Fig. 1.

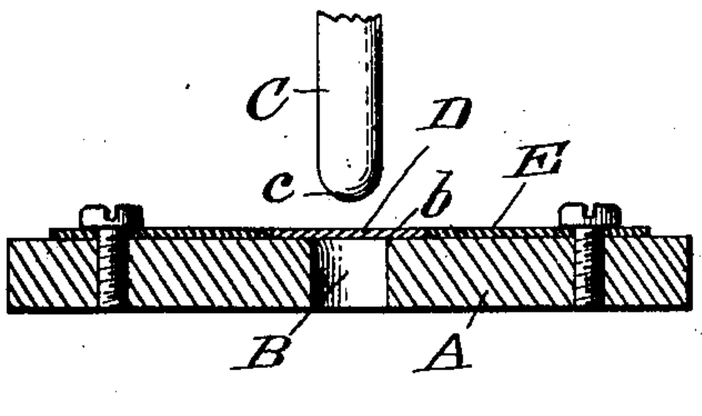


Fig. 3.

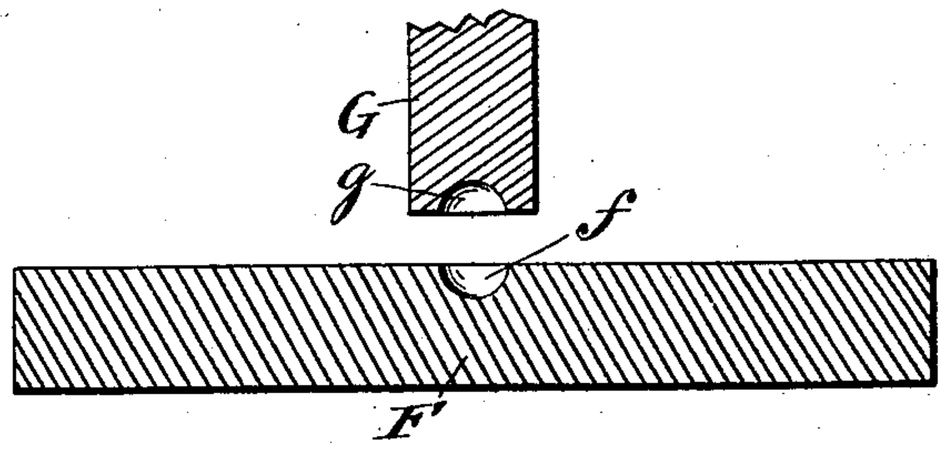
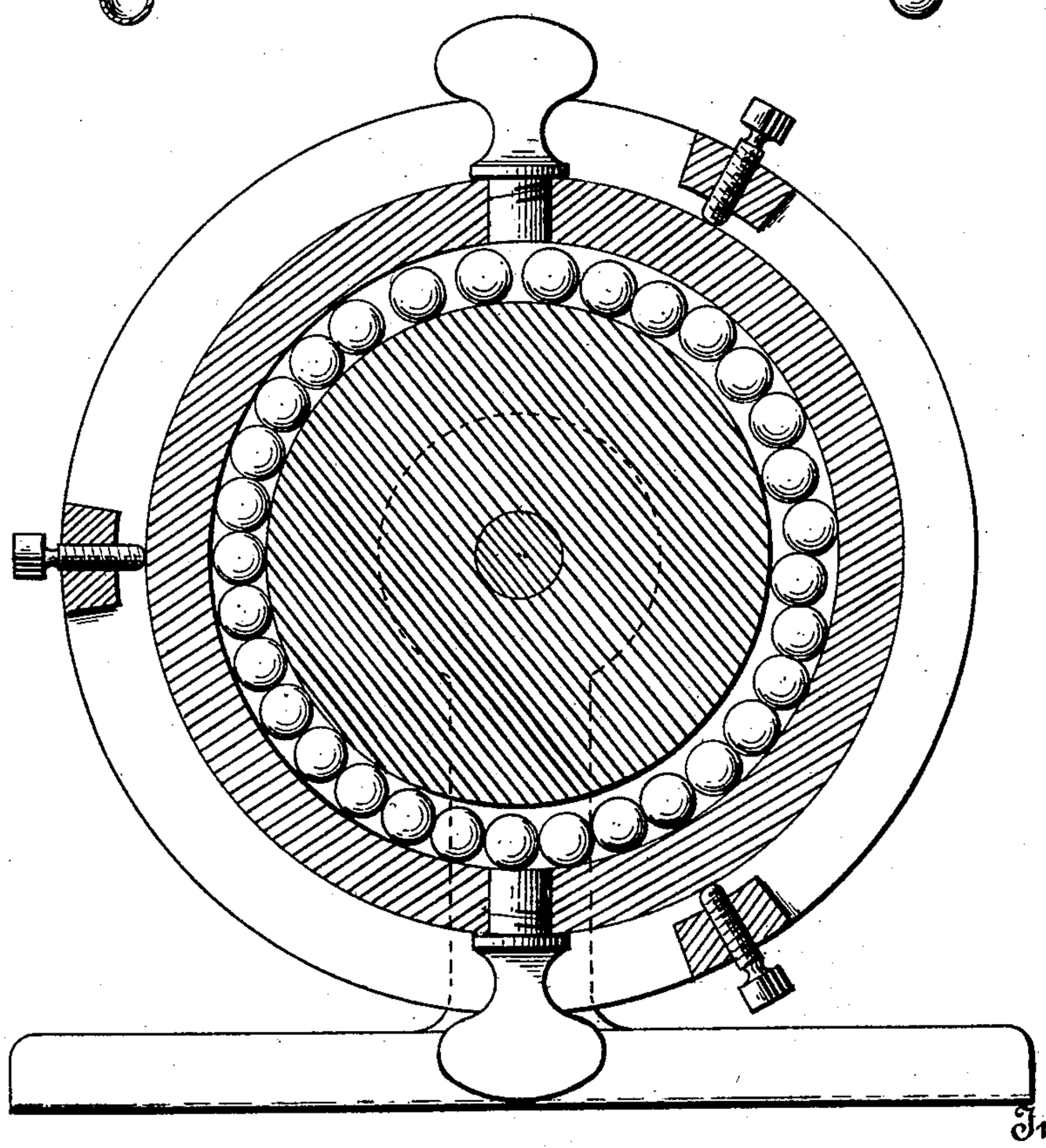


Fig. 2.

Fig. 4.

Fig. 5.



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ALLEN JOHNSTON, OF OTTUMWA, IOWA.

METHOD OF MAKING HOLLOW BALLS.

SPECIFICATION forming part of Letters Patent No. 698,707, dated April 29, 1902.

Application filed September 20, 1901. Serial No. 75,904. (No model.)

To all whom it may concern:

Be it known that I, ALLEN JOHNSTON, a citizen of the United States, residing at Ottumwa, in the county of Wapello and State of Iowa, have invented certain new and useful Improvements in Methods of Making Hollow Balls, of which the following is a specification.

My invention relates to methods for making hollow metallic spheres, and has for its object to provide a method of making balls out of a single piece of metal, in which method said balls are individually and successively subjected to constantly and gradually increasing pressure.

Referring to the drawings, Figure 1 is a view of the die and punch utilized in the first step of my process; Fig. 2, the result of the step shown in Fig. 1; Fig. 3, a view of the punch and die used in the second step in the process, and Fig. 4 the ball that results from step illustrated in Fig. 3. Fig. 5 is a view of the machine used for reducing and finishing the balls.

In the drawings, A represents a die, having the hole B therein, the upper edge thereof being rounded, as shown at *b*.

C represents the punch, having the convex end *c*, and D the blank to be treated.

E is a gage for centering the blank.

F represents the lower plate of a machine for forming the ball having the hemispherical depressions *f* in its face, while G represents a punch having a hemispherical depression *g* in its striking end opposite the depression *f* in the plate F. The die and plate are fixed to the bed-piece of any suitable machine, while the punches are operated in the ordinary manner of operating power-punches.

In my process I first take a blank of suitable size and shape and lay it over the hole B in the die-plate, as shown in Fig. 1. The punch is then brought down and the blank D pressed through the opening, the rounded upper edge *b* of the hole preventing abrasion and breaking of the metal. When the end of this operation is attained, the blank has been made to assume the cup-like shape shown in Fig. 2, the bottom thereof being hemispherical in shape. The cup-shaped blank is then placed in the depression of the plate F, preferably with the open portion of the cup downward, though the open portion of the cup may be upward, if desired, experience teaching me, however, that it is better to have the open portion downward. By bringing the punch G down the edge of the cup is brought together and the cup pressed into a spherical body. The diameter of the cup shown in Fig. 2 is slightly less than the diameter of the ball shown in Fig. 4, so that the edge of the cup is readily seated in the hemispherical depression *f*, the operation of forming the ball causing the barrel portion of the cup to bulge, because of the compression on the curved bottom and the edge of cup. A light stroke of the punch G on the cup would form said cup into a sphere without materially compressing the substance thereof and in some instances might not bring the edges of the cup into contact with each other. Hence I prefer to apply sufficient force to the punch to compress the substance of the sphere or ball to the extent of bringing the edges thereof into close contact and swaging and condensing the substance. Such operation might form a rim or bur on the periphery of the sphere at the meeting line of the punch G and plate F, and said rim or bur would be rolled down and polished to the surface of the ball in the further operation about to be described. The ball thus formed will have one segment formed of the meeting edges of the top of the cup, while the segment diametrically opposite thereto will be the part that had been the curved bottom of the cup as formed by the first operation. This curved bottom being the part that had been under and in contact with the end of the punch when pushed through the hole, the result would be that the metal in that part would be spread slightly in the operation and the particles open or porous. To press the meeting edges firmly together and restore the particles that had been the rounded end of the cup to their former density, I roll the ball by means of the machine shown in Fig. 5 of the drawings and more fully shown and described in application for patent executed by me on September 17, A. D. 1901, and filed September 20, 1901, and numbered 75,903. In the use of this machine the spherical bodies formed by closing the edges of the cup are subjected individually and successively to constantly and gradually increasing pressure until the diameter of each

ball is slightly reduced to a predetermined degree by constant pressing on the various poles thereof at various times and the ball gradually condensed until its surface becomes truly spherical, polished, and hardened.

The machine for polishing and hardening the balls has a central rotatable disk grooved on its edge and an adjustable ring grooved on its inner annular surface opposite the groove on the edge of the disk. One side of this ring is made to fit against the edge of the disk so closely that the balls are pressed while going through, while the other side is spaced apart from the disk, so that the balls jostle against each other and cause them to turn over, so that at each succeeding passage of the ball through the narrowed space between the disk and ring a different axis of the ball is presented therebetween. This eccentric arrangement of disk and ring is an important feature in carrying out my process, since by and through it I am enabled to subject the spheres individually and successively to constantly and gradually increasing pressure, and the balls rolled therein have their surfaces pressed, swaged, reduced, and condensed into proper shape and hardened polished condition, whereby all rim, bur, or inequalities of surface are rolled down and polished, qualifying said balls for use in bearings.

Having thus described my invention, what I claim is—

1. The process of making hollow metal bearing-balls, which consists in forming a cup, closing the edge of the cup to form a sphere, and subjecting the same to increasing rolling pressure on its various axes, thereby truing and condensing the surface as set forth.

2. The process of making hollow metal bearing-balls, which consists in forming a cup having an irregular edge, closing the edge of the cup to form a sphere, and subjecting the same to increasing rolling pressure on its various axes, thereby truing and condensing the surface of said sphere.

3. The method of making a hollow metal ball consisting of shaping a piece of metal of suitable size into a cup, then closing the edges of the cup to form a hollow sphere, and finally subjecting said hollow sphere to pressure at its various axes.

4. The process of making hollow metal bearing-balls, which consists of shaping a metal blank into a cup, closing the edges of the cup to form a sphere and subjecting the same to a gradually-increasing rolling pressure on its various axes as set forth.

5. The process of making hollow metal bearing-balls, which consists of shaping a sheet-metal blank into a cup, closing the edges of the cup to form a sphere, and subjecting the same to a gradually-increasing rolling pressure on its various axes.

6. The process of making hollow metal bearing-balls, which consists of shaping a metal blank into a cup having an irregular edge, closing the edge of the cup to form a sphere, and subjecting the same to a gradually-increasing rolling pressure on its various axes.

7. The process of making hollow metal bearing-balls, which consists of shaping a sheet-metal blank into a cup having an irregular edge, closing the edge of the cup to form a sphere, and subjecting the same to a gradually-increasing rolling pressure on its various axes.

8. The process of making hollow metal bearing-balls, which consists of shaping a metal blank into a cup, approximating the edges of the cup, to form a sphere, and subjecting the sphere repeatedly to gradually-increasing rolling pressure on its various axes, thereby pressing, swaging and condensing the surface of the same into a hardened polished condition as set forth.

9. The process of making hollow metal bearing-balls, which consists of shaping a sheet-metal blank into a cup, approximating the edges of the cup to form a sphere, and subjecting the sphere repeatedly to gradually-increasing rolling pressure on its various axes, thereby pressing, swaging and condensing the surface of said sphere into a hardened, polished condition.

10. The process of making hollow metal bearing-balls, which consists of shaping a metal blank into a cup having an irregular edge, approximating the edge of the cup to form a sphere, and subjecting the sphere repeatedly to gradually-increasing rolling pressure on its various axes, thereby pressing, swaging and condensing the surface of said sphere into a hardened, polished condition.

11. The process of making hollow metal bearing-balls, which consists of shaping a sheet-metal blank into a cup having an irregular edge, approximating the edge of the cup to form a sphere, and subjecting the sphere repeatedly to gradually-increasing rolling pressure on its various axes, thereby pressing, swaging and condensing the surface of said sphere into a hardened, polished condition.

12. The process of making hollow metal bearing-balls, which consists of shaping a square sheet-metal blank into a cup, closing the edges of the cup to form a sphere, and subjecting the same to a gradually-increasing rolling pressure on its various axes.

13. The process of making hollow metal bearing-balls, which consists of shaping a square sheet-metal blank into a cup, approximating the edges of the cup to form a sphere, and subjecting the sphere repeatedly to gradually-increasing rolling pressure on its various axes, thereby pressing, swaging and condensing the surface of the same into a hardened, polished condition.

In testimony whereof I hereto affix my signature in the presence of two witnesses.

ALLEN JOHNSTON.

Witnesses:
S. F. RANDOLPH, Jr.,
D. A. GOURICK.