No. 747,436. PATENTED DEC. 22, 1903.

A. JOHNSTON.

BALL BEARING.

APPLICATION FILED JAN. 13, 1902.

NO MODEL.

Fig. 2.

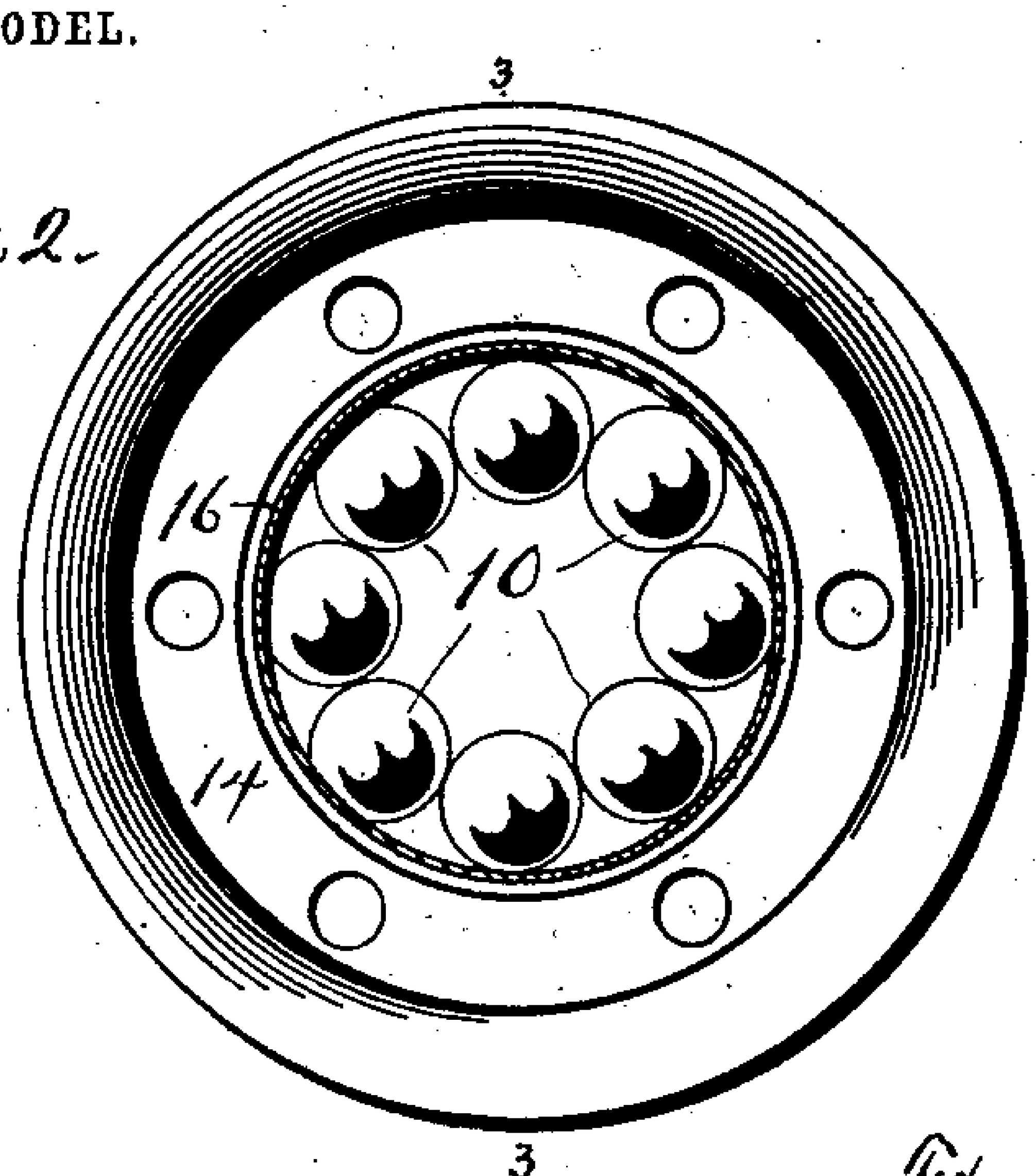


Fig. 1.

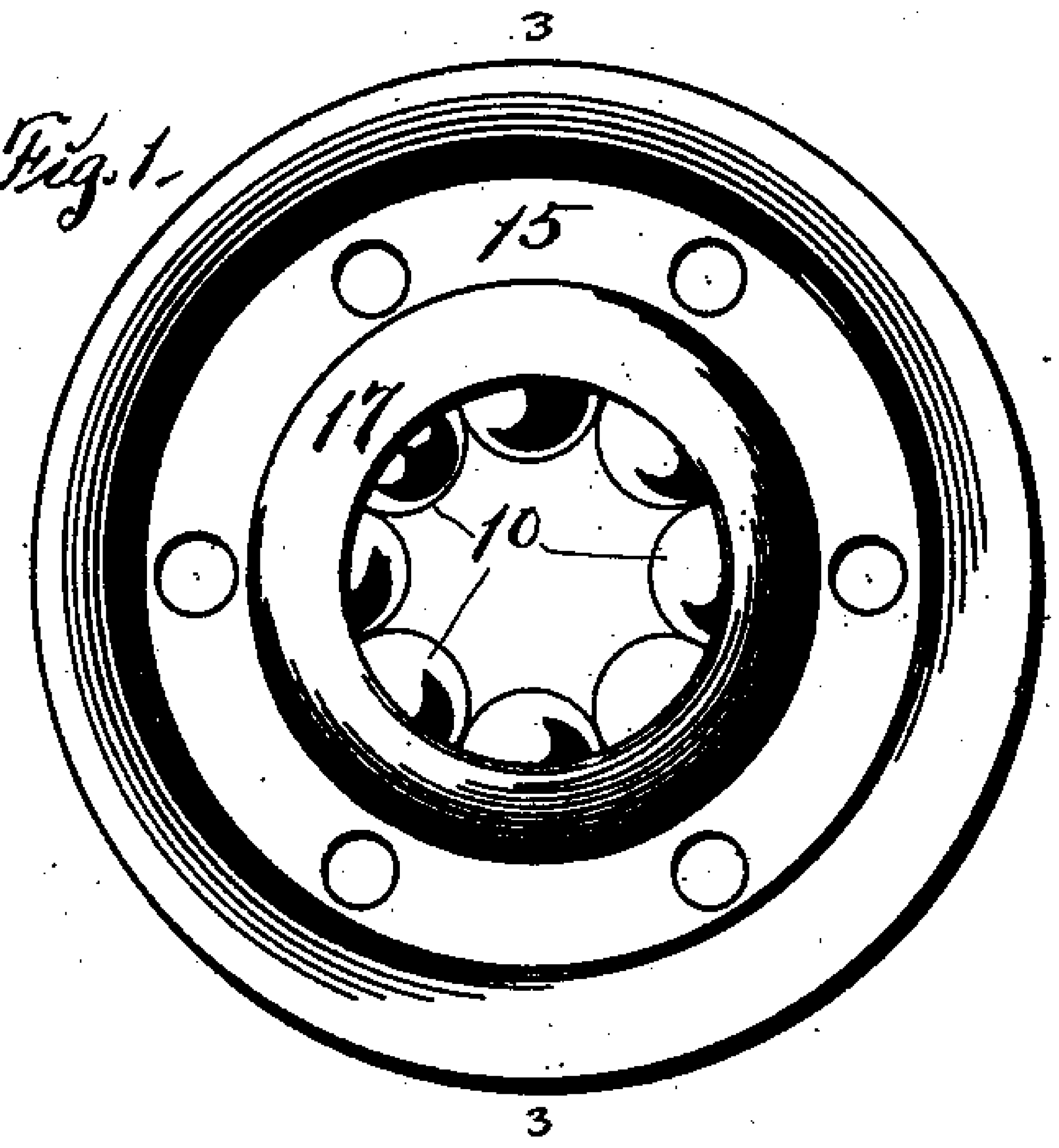


Fig. 4.

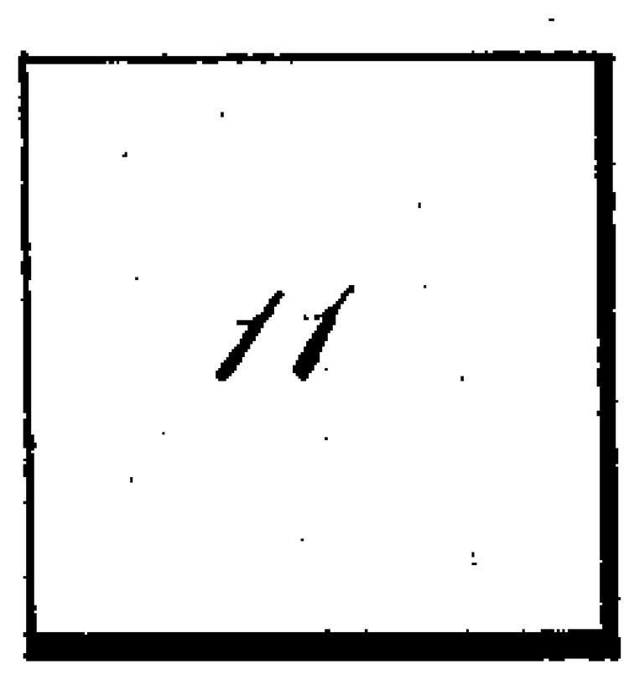


Fig. 5.

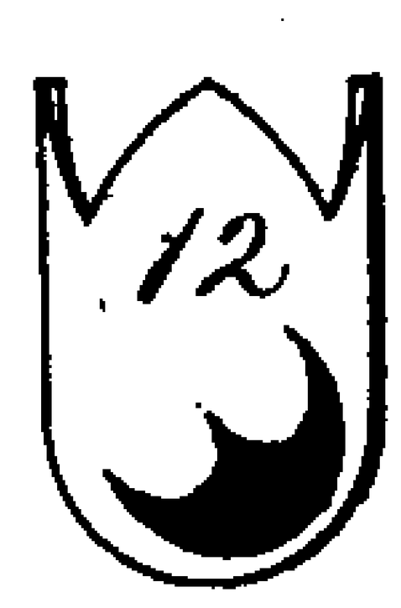
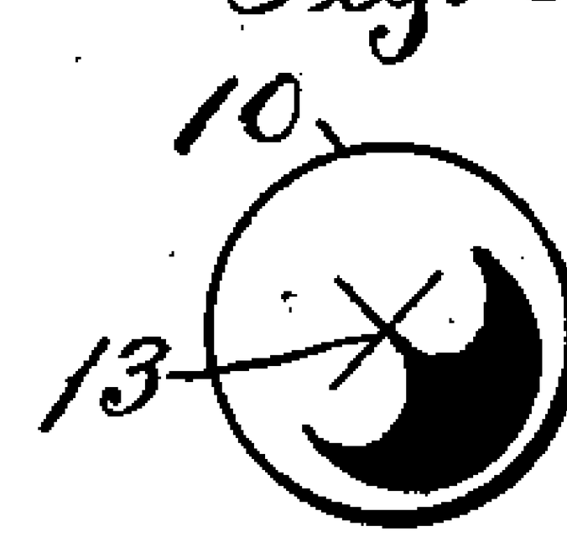


Fig. 6.



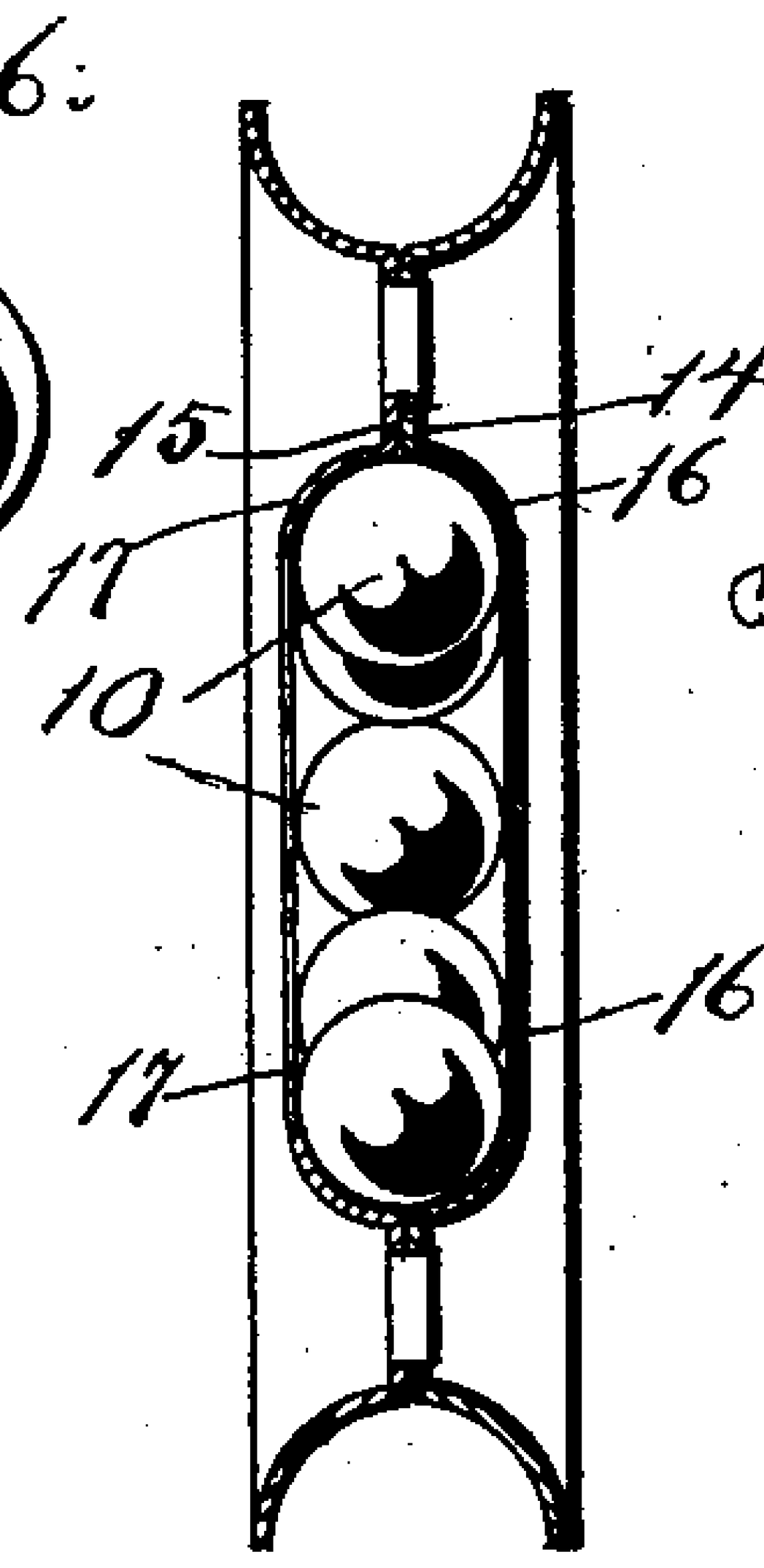
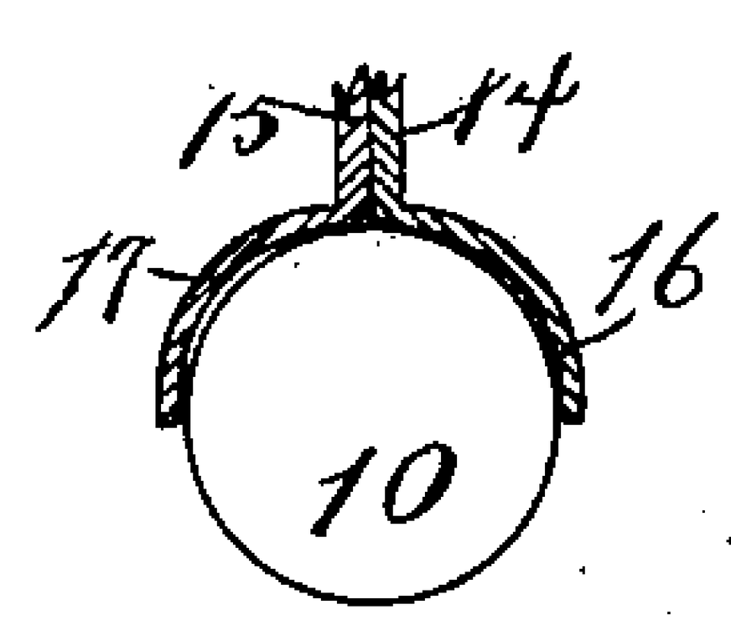


Fig. 3.

Fig. 7.



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296

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 747,436. Patented December 22, 1903.

UNITED STATES PATENT OFFICE.

ALLEN JOHNSTON, OF OTTUMWA, IOWA.

BALL-BEARING.

SPECIFICATION forming part of Letters Patent No. 747,436, dated December 22, 1903.

Application filed January 13, 1902. Serial No. 89,454. (No model.)

To all whom it may concern:

Be it known that I, ALLEN JOHNSTON, a citizen of the United States of America, and a resident of Ottumwa, Wapello county, Iowa, have invented a new and useful Ball-Bearing, of which the following is a specification.

The object of this invention is to provide an improved ball-bearing in so far as the bearing-balls and a race therefor are concerned, which ball-bearing is susceptible of use in divers locations and under various conditions.

A further object of this invention is to provide means for combining a ball-race and bearing-balls designed to form parts of a roller-bearing susceptible of independent manufacture, transportation, and storage, and designed to be employed in divers locations and under various conditions.

My invention consists in the combination, with a raceway, of a gang of balls, one or more of which are hollow resilient metallic balls, said balls being preferably each made of a single piece of sheet metal and trued and condensed.

My invention further consists in the combination of hollow bearing-balls arranged in an annulus and held in said annulus by mutual retentive contact.

My invention consists, further, in the combination of an annulus with a raceway on its inner surface and a plurality of hollow resilient spherical metal bearing-balls mounted in mutual contact in said raceway of annulus.

My invention consists, still further, in the construction, combination, and arrangement of elements hereinafter set forth, pointed out in my claims, and illustrated by the accompanying drawings, in which—

Figure 1 is a side view illustrating the combination of an annulus and a series of bearing-balls therein. Fig. 2 is a side view illustrating an annulus and a series of bearing-balls therein, the annulus being shown in section. Fig. 3 is a diametrical sectional view on the indicated line 3 3 of Fig. 1. Fig. 4 is a view of a blank from which the bearing-balls shown in Figs. 1, 2, and 3 may be made. Fig. 5 illustrates a cup formed by stamping the blank shown in Fig. 4. Fig. 6 illustrates a hollow bearing-ball made from the cup illustrated in Fig. 5. Fig. 7 is an enlarged fragmental view of the raceway in section and one ball.

In the construction of the device as shown the numeral 10 designates a hollow bearing-ball.

As hollow bearing-balls suitable for employment in an annulus are not now known to the public and their construction is not obvious nor apparent from the inspection of prior patents in this art, I deem it advisable to explain the means employed by me in producing such a ball susceptible of the use hereinafter set forth.

The hollow bearing-ball 10 may be made from a blank of sheet metal 11 of rectangular or other shape struck up, stamped, or pressed by means of a die and punch into a cup 12, as illustrated in Fig. 5, and then pressed into spherical form by means of another punch in such a manner that its edges are closed into contact. The balls as they come from the dies which last act on them are in some instances not a true geometric sphere, and their exterior surface is sometimes more or less rough. Furthermore, in some instances the dies form a bur or ridge around the ball. For the purpose of removing these imperfections the ball may be rolled on its various axes and reduced in diameter, compressed, polished, hardened, and finished to present a smooth truly spherical exterior surface or periphery imperforate except for the closely-contacting edges shown at 13 in Fig. 6.

Letters Patent of the United States No. 698,707, granted to me April 29, 1902, and No. 709,409, granted to me September 16, 1902, disclose, respectively, a process and an apparatus suitable for reducing, hardening, condensing, and truing the surfaces of the balls.

The hollow bearing-balls 10 are designed for use in roller-bearings wherein the strain or weight applied thereto will not exceed the crushing resistance of said balls. Hence the thickness of the metal blank 11 may vary somewhat in respect of the use to which the balls are to be put, thus producing balls of varying degrees of strength or possessing varying degrees of crushing resistance.

Hollow bearing-balls used in carrying out this invention are preferably slightly resilient, the degree of resiliency depending upon

the size of the ball and the character and weight of metal used in making the same. This resiliency of the balls yields important advantages, as explained hereinafter.

An annulus is provided, preferably made of two plates 14 15 of circular form and centrally apertured, which plates are counterparts of each other. A fluted ring 16 is formed on and pressed out of the inner margin of the plate 14 and is concaved in cross-section, preferably on a radius perceptibly less than the radius of the ball 10. A similar fluted ring 17 is formed on and pressed out of the inner margin of the plate 15 and is similarly curved in cross-section. The outer margins of the plates 14 15 may be finished in any desired manner—as, for instance, with fluted rings diverging in cross-section to form a grooved rim or with a plane finish susceptible of attachment to a ring or annulus of different form or with an expanded rim plane in cross-section and susceptible of use as a pulley. The shape of the rims of the plates 14 15 is not of moment here, as it forms no part of this invention.

The plates 14 15 are connected by means of hollow rivets or any other desired means through their parallel contacting body portions. The plates 14 15 may be made exact counterparts of each other by stamping or pressing from sheet metal with the same punch and die; but I have found it advisable to punch the holes in the plane body portion of the plate 15 of less diameter than the holes punched in the plane body portion of the plate 14 and when said plates are contacted, as shown, expand the margins of the holes in the plate 15 through and rivet the same on the margins of the holes of the plate 14, thus providing a rigid connection for said plates susceptible of production at a minimum of cost and trouble. A plurality of the hollow bearing-balls 10, in this instance eight in number, are mounted in an annulus and contact at two points with the concave faces of each of the fluted rings 16 17, as illustrated in Figs. 1, 2, and 3. It will be observed that the sum of the diameters of the eight bearing-balls 10 mounted in the annulus is greater than the length of an imaginary line concentric with the line of contact of the balls on the rings 16 17 intersecting the points of contact of the balls with each other. It follows, therefore, that seven of the balls 10 may be mounted freely in the concaved race of the annulus when the plates of said annulus are rigidly connected and that in order to insert the eighth ball all of the balls must yield or be compressed an amount sufficient to permit said eighth ball to pass radially between two of the others to its seat. The balls being hollow, compressible, and yielding, it has been found by experiment that eight of them in series will compress or yield diametrically sufficient for the seating of the eighth ball in the concaved race of the annulus. Thus a series of eight balls five-sixteenths of an inch in diameter will yield or compress about .03 of an inch.

The sum of the diameters of eight of the balls 10 is less than the length of a line concentric with the line of contact of the balls on the fluted rings 16 17 and spaced from the apex of the race a distance equaling the radius of one of the balls. Hence when the eight balls 10 are mounted in the annulus they will contact loosely with each other and a curved line intersecting the points of contact of successive balls may not be a true circle, inasmuch as when mounted on a horizontal axis the uppermost balls of the row will sag slightly, as shown in Figs. 1 and 2. However, the weight of the bearing-balls 10 is materially less than that of solid balls of the same diameter, and the rigidity thereof is such that said balls will not compress or yield diametrically of their own weight or because of agitation or shaking, and thus become dislodged from the annulus. Thus it requires a material and considerable pressure either to seat the eighth ball of the series or to unseat either of the said balls from the annulus when the row thereof is complete. Thus it appears that the balls may be mounted in the annulus and packed, transported, stored, or otherwise handled with safety and applied to and mounted in various forms of ball-bearings.

I have not illustrated nor described herein any form of cone or axis upon which the balls 10 may have rolling contact, for the reason that various forms of center devices or axles may be employed and the construction or production thereof constitutes no part of my present invention and many different forms thereof are now common and well known in the art of roller-bearings.

It is obvious that I may employ an annulus of any suitable construction and shape in cross-section.

In a ball-bearing having the ordinary solid non-resilient balls arranged in a vertical position and supporting a shaft or axle practically the entire load falls upon the balls separately in succession. The tendency therefore is to concentrate the entire crushing force and strain or load on each ball separately. Furthermore, with the raceway fixed and the shaft rotatable in such arrangement the entire wear would be concentrated upon a point under the lowermost ball, and, vice versa, with the raceway rotatable and the shaft fixed the entire wear would be concentrated upon the upper part of the latter. By employing slightly-resilient balls, however, the balls yield and communicate pressure from one to another, so that the strain and wear are distributed between and the load is carried by a number of the balls instead of being concentrated upon each ball separately, as is the case where solid balls are used.

I am aware that solid bearing-balls have been mounted between keeper-plates, which

keeper-plates are detachable, removable, and replaceable relative to each other, and I do not claim such construction.

What I do claim, and desire to secure by Letters Patent of the United States, is—

1. In a ball-bearing, the combination with a raceway, of a gang of balls, one or more of which are hollow resilient metallic balls.

2. In a ball-bearing, the combination with a raceway, of a gang of hollow resilient metallic balls.

3. In a ball-bearing, the combination with a raceway, of a gang of hollow resilient balls, each made of a single piece of sheet metal.

4. In a ball-bearing, the combination with a raceway, of a gang of hollow resilient trued and condensed balls each made of a single piece of sheet metal.

5. The combination of an annulus and a series of hollow bearing-balls, said balls mounted in mutually-retentive contact within said annulus.

6. In a ball-bearing, the combination with a raceway of a gang of hollow, resilient, metallic bearing-balls mounted in said raceway in mutually-retentive contact.

7. An annulus formed with an annular race on its inner surface and a plurality of hollow, resilient bearing-balls sprung into retentive position in said race, each ball being loosely revoluble within said race.

8. The combination of an annulus formed with a raceway on its inner margin and a plurality of hollow, resilient, spherical bearing-balls mounted within said race, in mutually-retentive contact, each of which balls is made from a blank of sheet metal.

9. An annulus formed with a concaved annular race on its inner surface and a plurality of hollow bearing-balls mounted in said race and contacting successively throughout the length of the race.

10. A sheet-metal annulus formed with a concaved race on its inner surface and a plurality of hollow bearing-balls mounted in said race in mutually-retentive contact.

11. A raceway for ball-bearings consisting of counterpart rings of sheet metal, each ring having its inner edge bent laterally and forming part of a raceway, in combination with a plurality of hollow, resilient bearing-balls sprung into mutually-retentive positions in said raceway.

12. An annulus formed with a race on its inner surface and a plurality of hollow, compressible, resilient bearing-balls mounted in said race, said balls conjunctively yielding to compression to allow one of them to pass through a space normally less than its diameter to seat or unseat said ball relative to the race.

13. An annulus formed with an annular race and a plurality of balls therein, said balls each made from a sheet-metal blank, the meeting edges of the blank contacted, said balls susceptible of compression to permit the springing of one of their number through a space between two of their number to seat or unseat relative to the race and expansible within the race, into loose, yet retentive, mutual contact.

14. An annulus formed of counterpart plates of sheet metal having an annular race on its inner surface, and a plurality of hollow, resilient bearing-balls sprung into retentive positions in said race, each ball being loosely revoluble within said race.

Signed by me at Ottumwa, Iowa, this 6th day of January, 1902.

ALLEN JOHNSTON.

Witnesses:
GEO. F. HALL,
F. W. SHARP.