

No. 861,403.

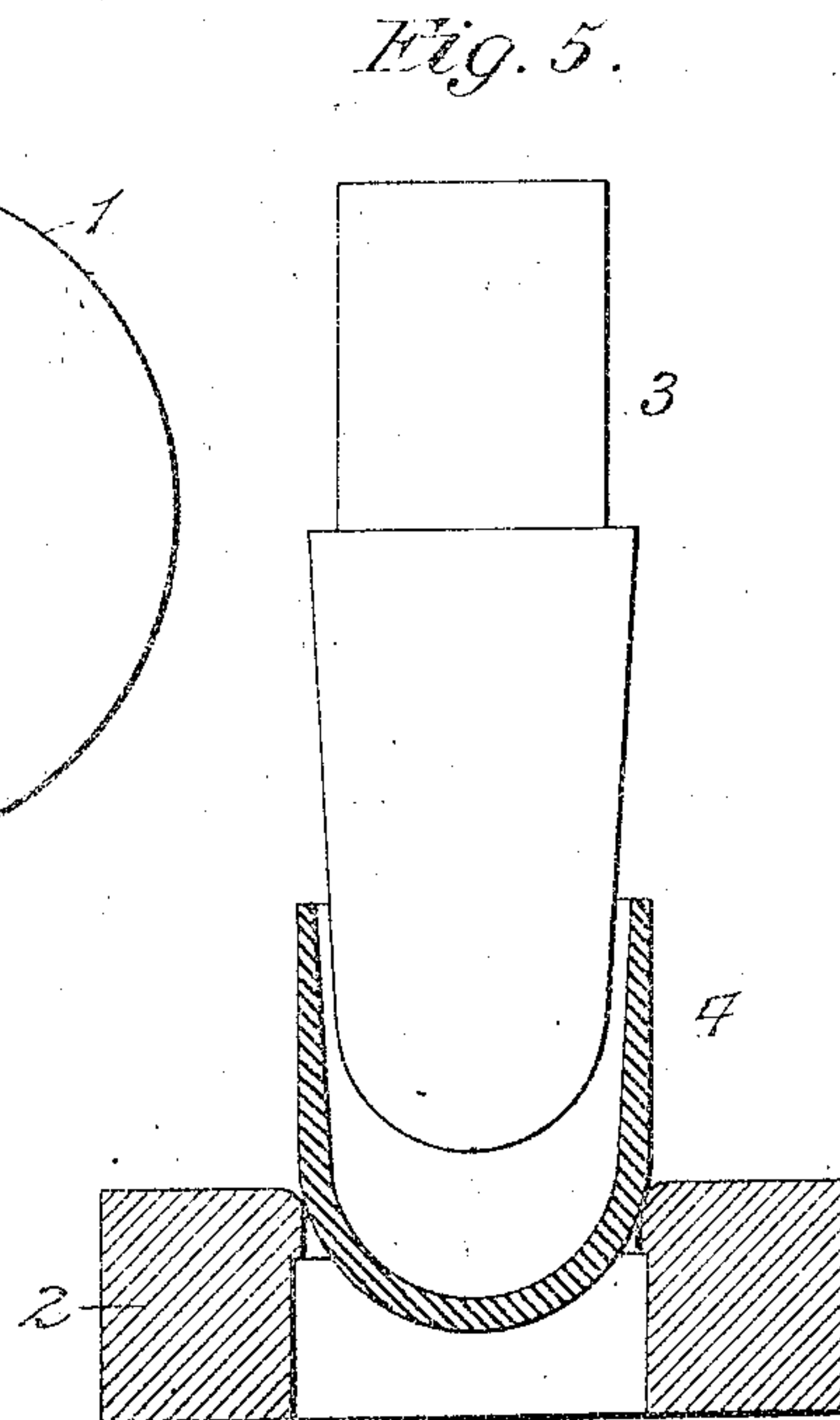
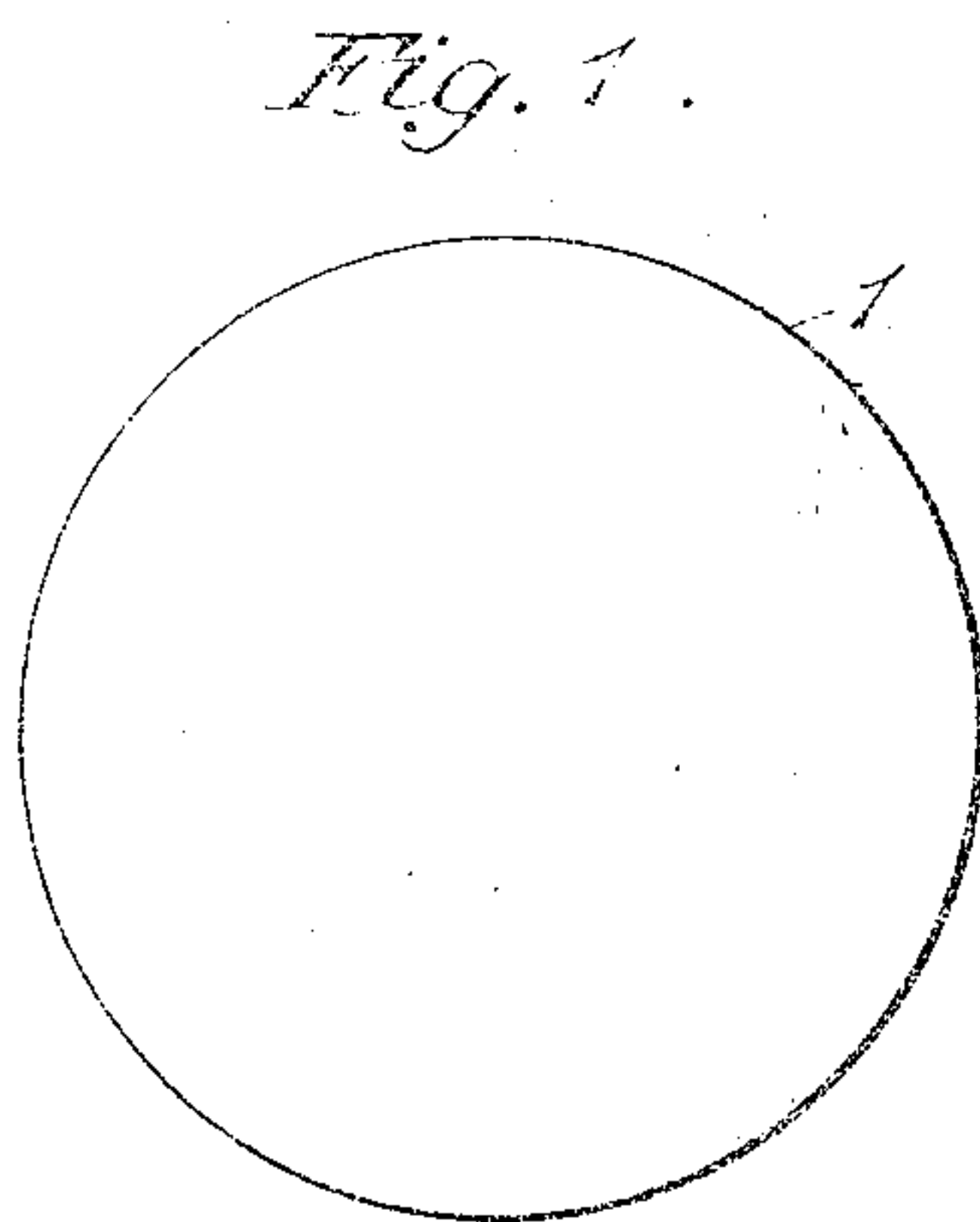
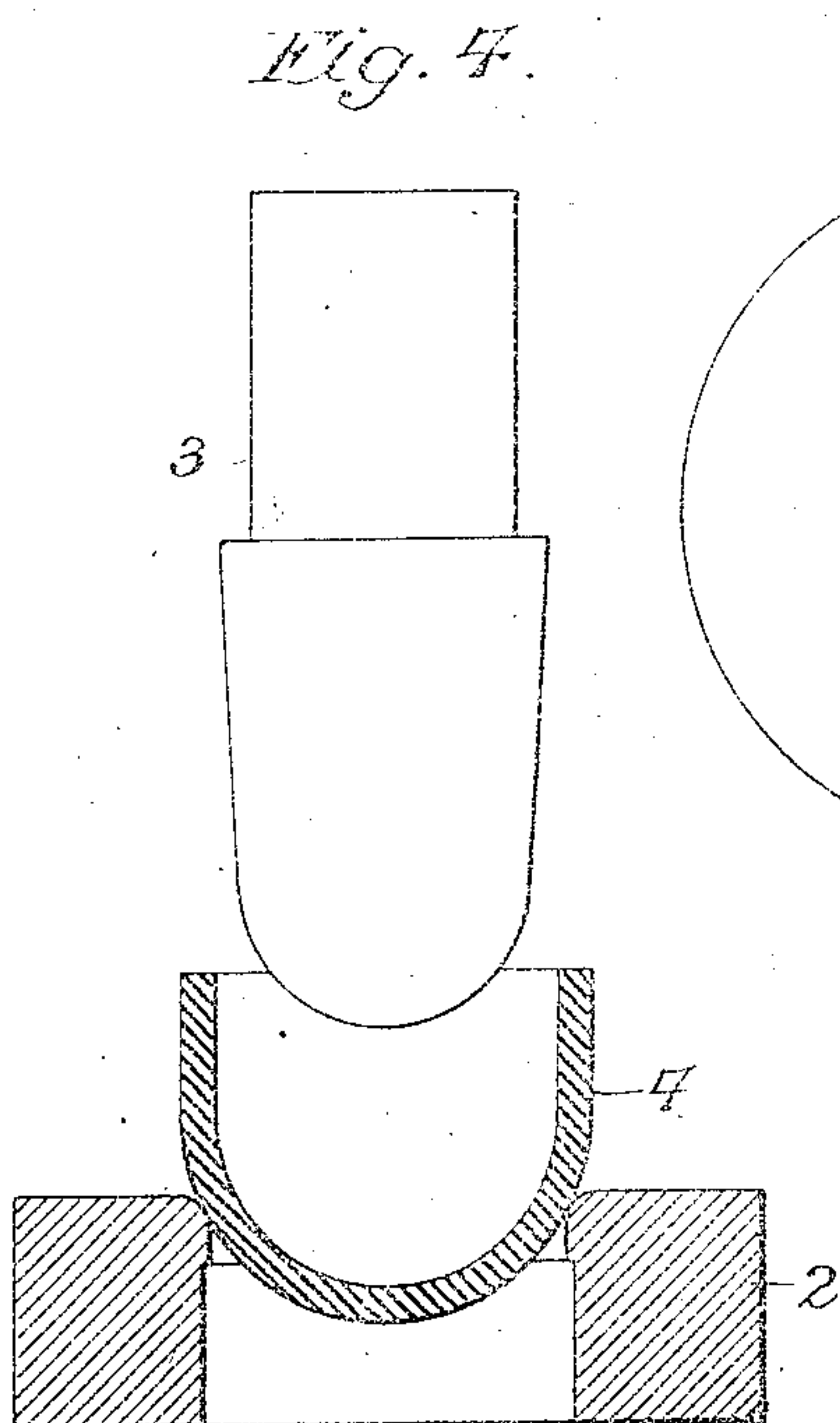
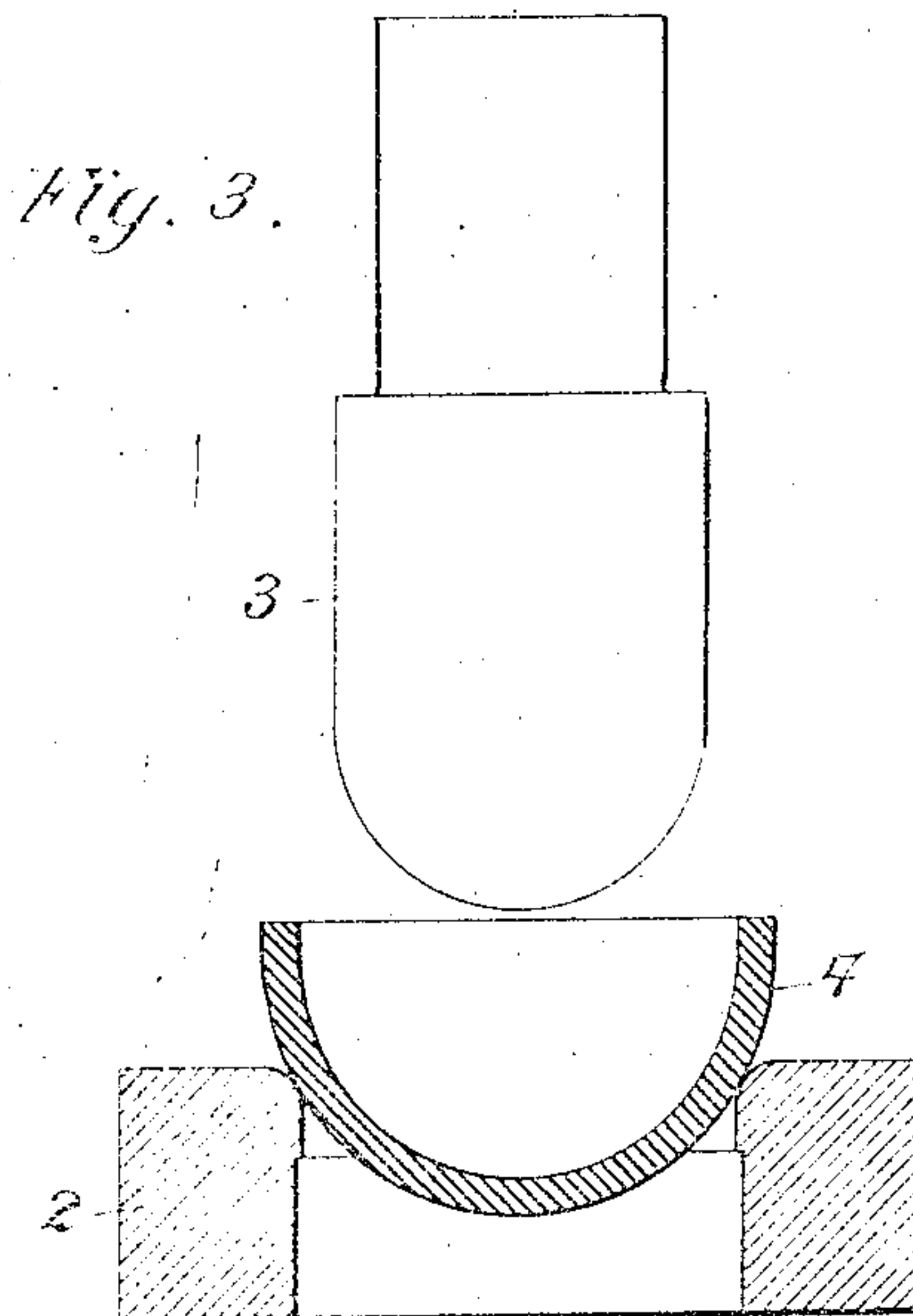
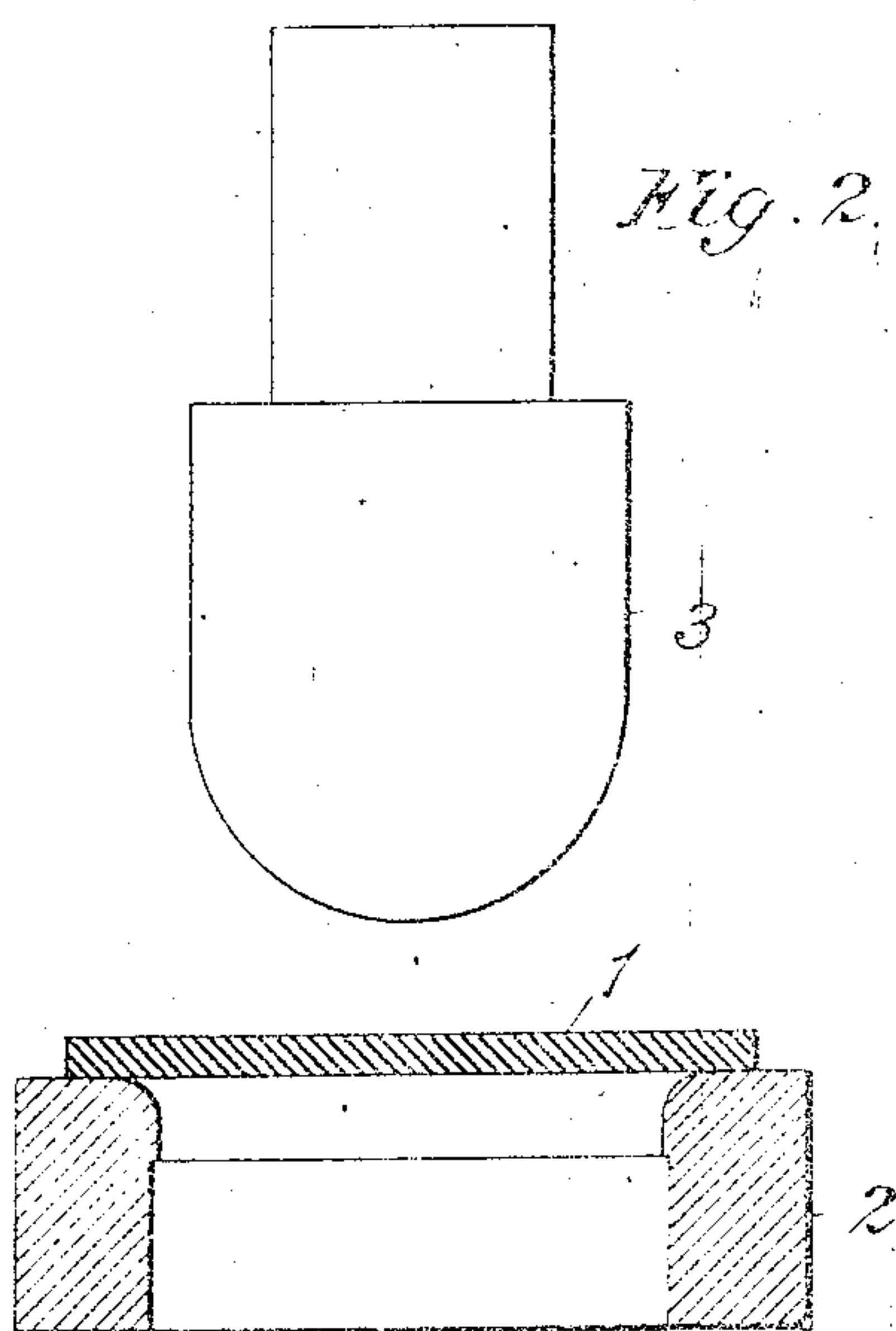
PATENTED JULY 30, 1907.

O. SPAHR.

METHOD OR PROCESS OF MAKING HOLLOW METAL BALLS.

APPLICATION FILED AUG. 17, 1906.

2 SHEETS—SHEET 1.



Witnesses
Edmund Bowland
M. F. Keating

Inventor
Otto Spahr
By his Attorney
Charles J. Kintner

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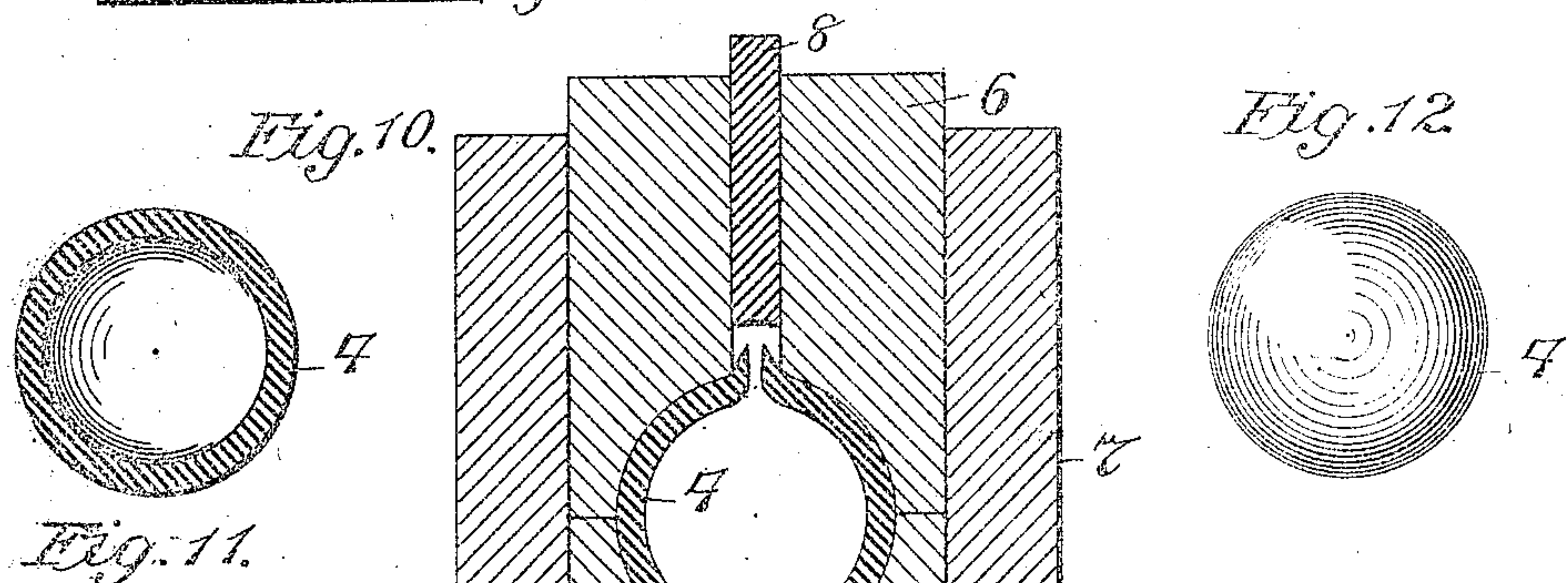
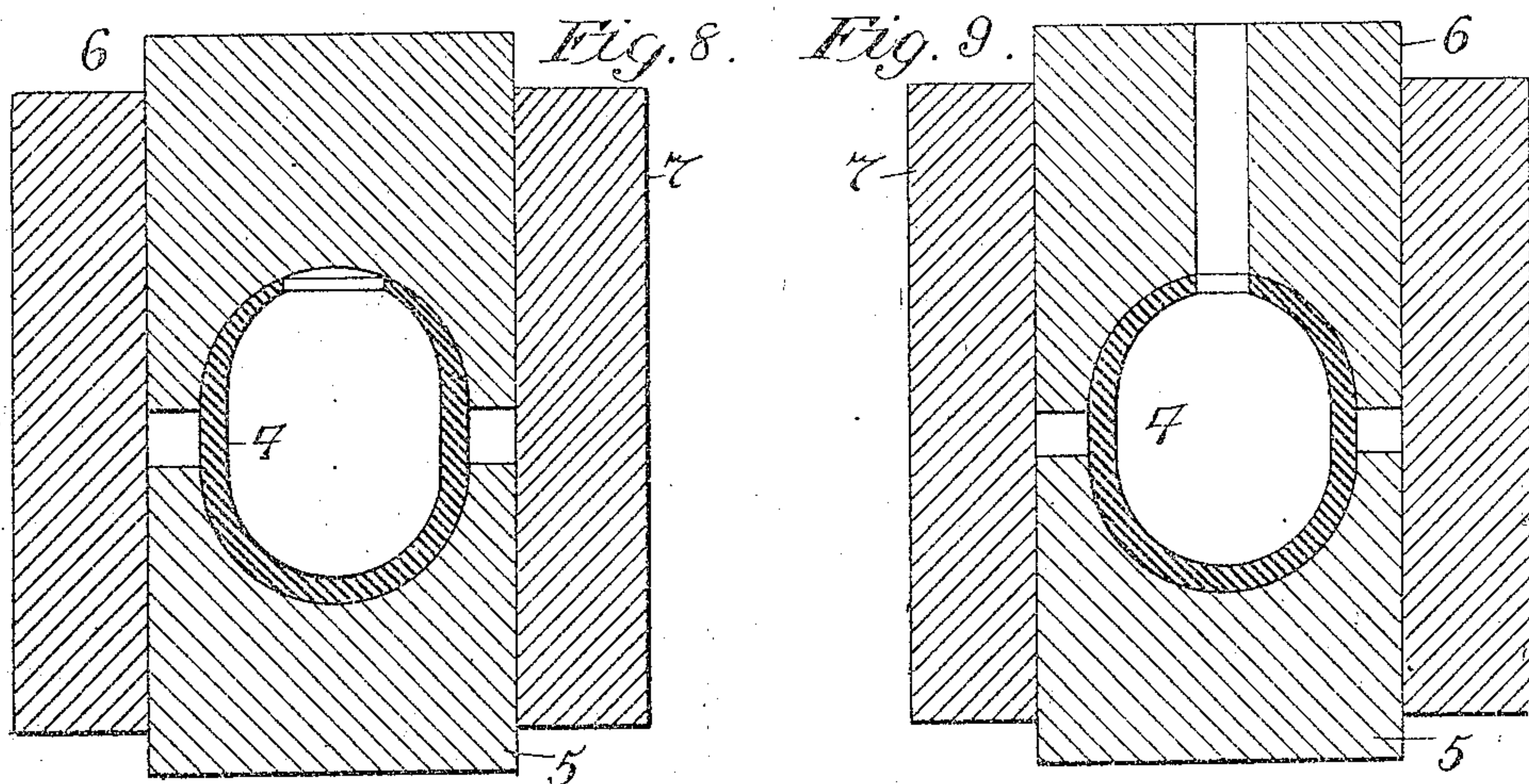
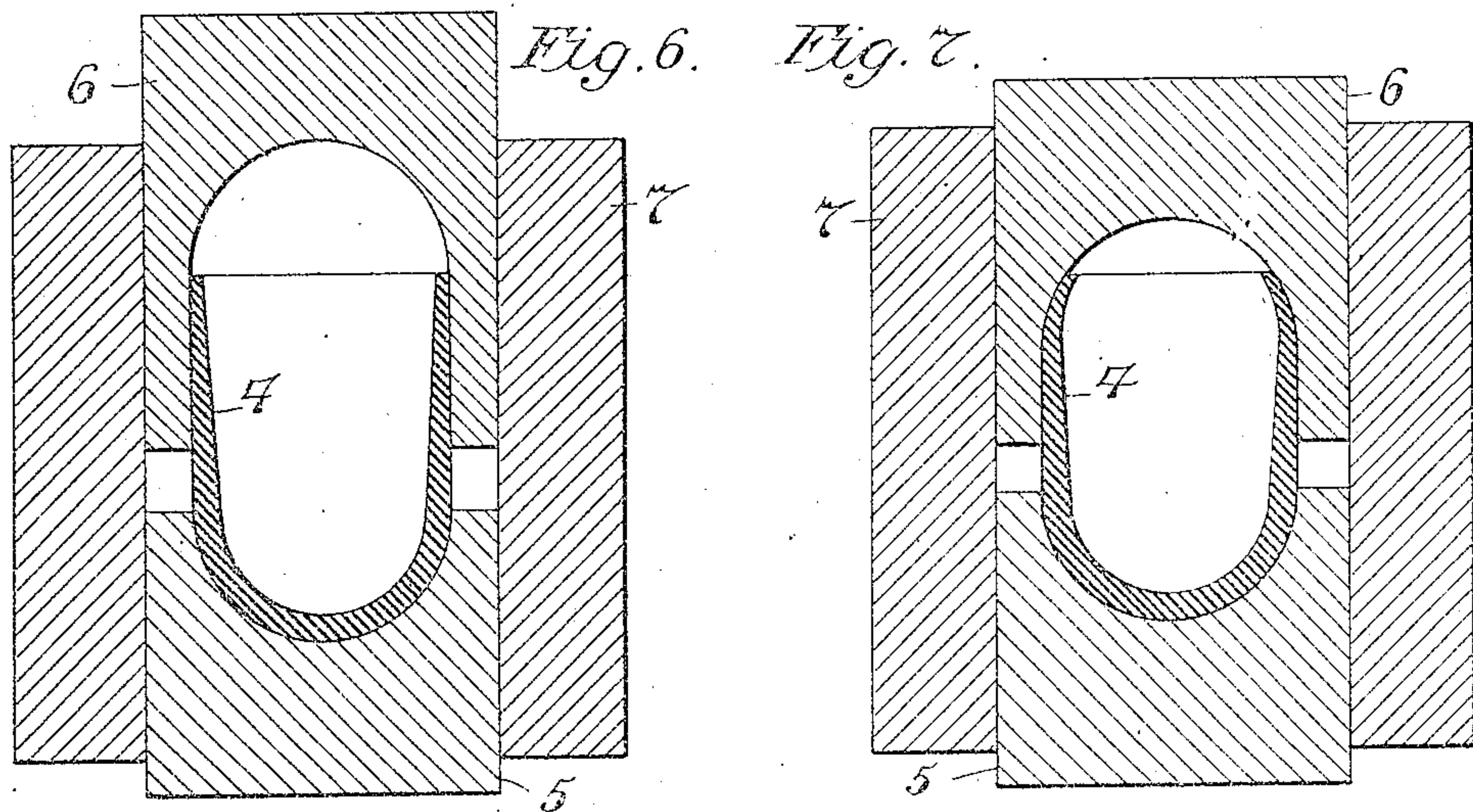
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UNITED STATES PATENT OFFICE.

OTTO SPAHR, OF PHILADELPHIA, PENNSYLVANIA.

METHOD OR PROCESS OF MAKING HOLLOW METAL BALLS.

No. 861,403.

Specification of Letters Patent.

Patented July 30, 1907.

Application filed August 17, 1906. Serial No. 331,008.

To all whom it may concern:

Be it known that I, OTTO SPAHR, a citizen of the United States, residing at Philadelphia, county of Philadelphia, and State of Pennsylvania, have made
5 a new and useful Invention in Method or Process of Making Hollow Metal Balls, of which the following is a specification.

My invention has for its objects—first, the production of a hollow metal ball having a shell of the same
10 relative thickness at every point of its internal and external surfaces: second, the production of a hollow metal ball possessing greater symmetry and strength than has been possible with such balls as heretofore devised. Third, the production of a hollow pressed
15 metal ball.

Prior to my invention it was old in the art to construct hollow metal balls by rolling a disk of metal first into hemispherical or cup form, the cup part of which had the same diameter as the completed ball and then
20 rolling the outer edge of the cup inward until the ball was completed, these successive steps being effected through the agency of rotary dies. Such balls, however, when completed are open to the objection that on the final completion thereof during the process of
25 turning in the edges of the cup there always results a surplus of metal so that the completed ball is not symmetrical. It was also old in the art to construct a hollow metal ball from a rectangular-shaped plate of metal by forcing the same through a die in such manner as to turn the corners of the plate upward, thus
30 forming a cylindrical cup having lateral and inwardly inclined edges, and afterwards closing the upper portion of the cup by successive steps due to pressure. Metal balls formed by this process are also open to the
35 objection that the surplus of metal which results from the completion of the ball at the open side of the cup makes the same non-symmetrical.

My invention overcomes this objectionable feature and I am enabled to make a pressed metal ball the internal and external surfaces of which are absolutely
40 concentric at all parts, thus providing a ball which is equally strong for all diameters thereof and is absolutely symmetrical. I accomplish this result through the agency of punches and dies so constructed and operated that a disk or mass of metal to be operated upon
45 is first caused to assume a hemispherical shape and then successive cylindrical shapes. I then cause the outer or open edge of the cylindrical part to be gradually thinned so that any longitudinal section thereof is of
50 a wedge-like nature. I then by successive steps cause the thin edge to be turned inward until the mass of metal assumes a spheroidal shape; finally compressing the metal into a spherical shape with a limited projection of such metal extending beyond the outer surface
55 of the sphere, which projection of metal is ultimately forced inward by pressure until the completed ball as-

sumes the desired symmetry. In this way I am enabled to make a hollow ball which is absolutely symmetrical throughout every portion thereof.

For a full and clear understanding of my invention, 60 such as will enable others skilled in the art to construct and use the same, reference is had to the accompanying drawings, in which

Figure 1 is a plan view of a metal disk to be operated upon, and, Figs. 2 to 5 inclusive are sectional views 65 taken through the dies and the material as it is successively subjected to the action of such dies, the punches for effecting the successive actions through the dies being shown in elevational view. Figs. 6 to 10 inclusive are sectional views taken through further successive forms of dies and their surrounding guiding sleeves, illustrating also in sectional view the successive conformation of the material being acted upon. Fig. 11 illustrates in sectional view a completed ball: 70 Fig. 12 is a side elevational view of such ball. 75

All of the drawings are made to scale and are designed to make a hollow metallic ball having an exterior diameter of $1\frac{1}{4}$ inches and an interior diameter of 1 inch.

Referring now to the drawings in detail and first to Figs. 1 to 4 inclusive, 1 represents the material to be 80 acted upon, shown in Fig. 1 as a metallic disk, preferably of steel and practically two and three-eighths inches in diameter and one-eighth of an inch thick; 2 being cylindrical dies of the conformation shown, each successive die being of slightly smaller diameter than 85 its predecessor. 3 represents a punch having a hemispherical end and of cylindrical cross section, as shown in Figs. 2 and 3, and a similar end but of cone-shape as shown in Figs. 4 and 5; said dies being successively smaller as will be apparent on examination of the drawings. 90

After the metal is subjected to the action of the die 3 in Fig. 2 it assumes the hemispherical shape illustrated by the number 4 and in position in Fig. 3 for the action of the punch in that figure, which action 95 gives to the same the cylindrical conformation shown in Fig. 4 where it is now ready for the action of the first punch having a conical conformation, and when subjected to this action it assumes the conformation shown in Fig. 5, being gradually thinned at its upper edge. 100 On forcing the punch 3 through the die 2 with the material in position as shown in Fig. 5, it is given the conformation shown in Fig. 6; that is to say, the upper edge is further thinned. It should be remarked in this connection that when metal of this nature, particularly steel, is subjected to such a process it becomes 105 brittle and liable to crumble or break and, therefore, it is important that the material shall be placed in an annealing oven and subjected to any of the well known processes of annealing for the purpose of putting it in 110 condition to proceed with the process. I have ascertained in practice that ordinarily this annealing and

reannealing should be effected at about every third or fourth operation, but the operator will be governed by his judgment on examining the metal under treatment, such matters being well within the skill of those versed in the manufacture of pressed metal articles.

After being subjected to the operation due to the die shown in Fig. 5 the material 4 is placed in a die of the conformation shown in Fig. 6 in which the lower half thereof is of hemispherical interior form and of the exact diameter of the exterior diameter of the ball to be produced. The upper half of this die is of the conformation shown and both of said halves are cylindrical exteriorly and fit accurately within a hollow cylindrical metal guiding sleeve 7. On forcing the dies 5 and 6 together the material assumes the position shown in Fig. 8 where it is again subjected to the action of an additional pair of dies 5 and 6, the lower one of which is the duplicate of the lower die shown in Fig. 6, the upper die having the conformation shown and adapted when the two dies are forced together to give to the material the conformation shown in Fig. 9, in which there is substituted for the die 6 of Fig. 8 a die of the conformation shown having a centrally located opening so arranged that when the dies are compressed still further and their faces brought together the material assumes the conformation shown in Fig. 10, the dies being now closed face to face; while there results an upwardly extending metallic neck as illustrated. An additional cylindrical male die 8 provided at its lower end with a curvature corresponding with the curvature of the exterior of the ball is now inserted and forced downward until the upper end is flush with the upper end of the die 6, thereby causing the material to be firmly set or united together so that the ball is completed and assumes the conformation shown in cross section in Fig. 11, which it will be noted is absolutely symmetrical throughout.

I have ascertained that a ball as thus constructed and especially when made of good steel possesses sufficient strength to meet with the requirements which are usually placed upon solid steel balls, this being due to the fact of the entire symmetry thereof, both inside and out.

I do not limit the application of my process to the use of the special tools illustrated in the accompanying drawings, as obviously some of the features thereof might be accomplished by different devices. To illustrate, instead of thinning the upper edge of the hemispherical part by a cone-shaped die, as shown in Fig. 4 of the drawings, this thinning step might be effected by placing the cup in a turning lathe and turning it out or by turning the outer surface of the cylindrical part of the cup downward so as to give to the mass of metal the same wedge-like shape in cross section. Also the same result might be effected by subjecting the cylindrical portion to the action of forging mechanism of such peculiar construction as would give the cup-like form shown in the drawings, my generic invention being of such a nature that I believe I am entitled broadly to the production of a metal ball or cup of hemispherical shape which is successively formed into a short cylinder or cylinders of different length, hemispherical at one end and then thinned

down to leave a sufficient mass of metal such that when the metal is again turned inward upon itself the amount thereof shall be sufficient to result in a hollow metal ball or sphere, absolutely symmetrical throughout all parts thereof and having, therefore, like strength throughout all parts thereof, and my claims are to be construed as of the most generic nature as to the method of operation and as to the resultant product, namely, a hollow symmetrical metal ball.

Although I have described a novel process of making a hollow symmetrical ball from sheet steel, I do not limit myself to the use of such metal, as obviously such balls may be made from any metal which may be acted upon by dies and punches in the manner indicated, and I have ascertained that in the manufacture of such balls from different kinds of metal practically the same process hereinbefore described may be effected, the annealing steps being made dependent upon the condition of the metal as the process proceeds and being applicable in accordance with the best judgment of the operator.

I make no claim in the present application to the novel ball which results from the practice of the process hereinbefore described and hereinafter claimed, as said ball is made, in accordance with the requirement of the Examiner, the subject matter of a divisional application filed in the U. S. Patent Office on the 14th day of March, 1907, bearing Serial No. 362,280.

Having thus described my invention what I claim and desire to secure by Letters Patent of the United States is—

1. The described process of making a hollow metal ball, consisting in first forming a mass of metal into a hemispherical cup; then simultaneously diminishing the diameter of the hemisphere and lengthening the body part of the cup into a cylindrical form; then thinning the body part thereof toward its outer edge and finally turning the thinned edge inward by successive bending and swaging steps until the mass assumes the form of a symmetrical spherical shell of the same cross section throughout.

2. The described process of making a hollow symmetrical metal ball, consisting in first compressing a disk of metal into the form of a hemisphere; then lengthening out the body part thereof into a cylindrical form; then gradually thinning said body part toward its outer edge and finally by the successive application of external pressure turning the thinned edge inward by successive bending and swaging steps until the mass assumes the form of a symmetrical spherical shell of the same cross section throughout, the material being subjected to an annealing process at various stages of the before-mentioned steps.

3. The described process of making a symmetrical hollow metal ball, consisting in subjecting a metal disk to pressure and in such manner as to form a hemisphere, then by the application of further pressure lengthening out the body part of the hemisphere and simultaneously reducing its thickness toward the edge thereof; then subjecting the same to an annealing process; then by successive bending and swaging steps due to pressure turning the thinned edge inward into spheroidal form; then again annealing, and finally further turning the edge inward under pressure by successive bending and swaging steps until the mass assumes the conformation of a perfect sphere.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

OTTO SPAHR.

Witnesses:

H. CURZON DORR
WALTER HOWE