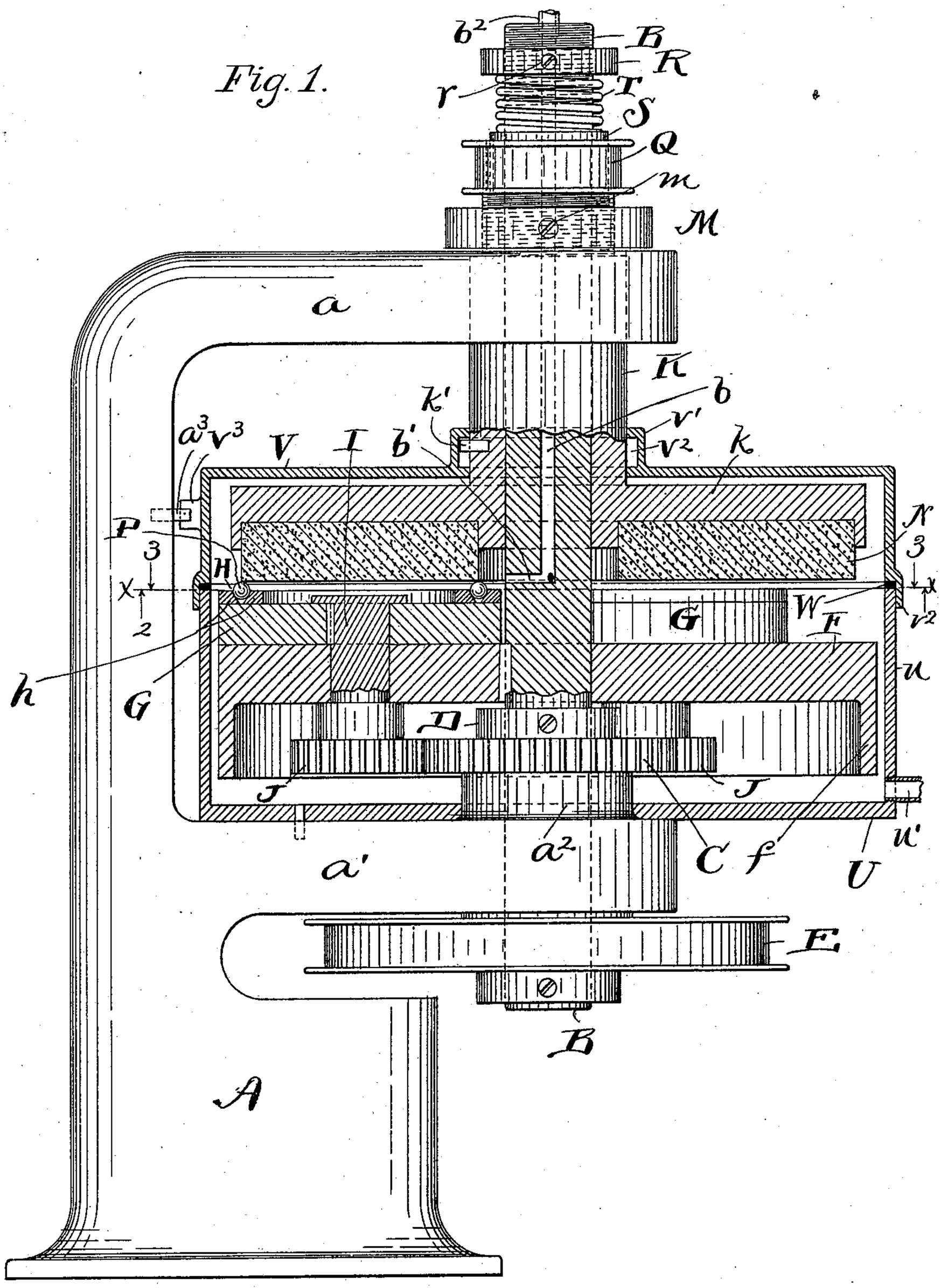
(No Model.) 2 Sheets—Sheet 1.

R. & L. F. SCHULZE.

BALL GRINDING MACHINE.

No. 602,365. Patented Apr. 12, 1898.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

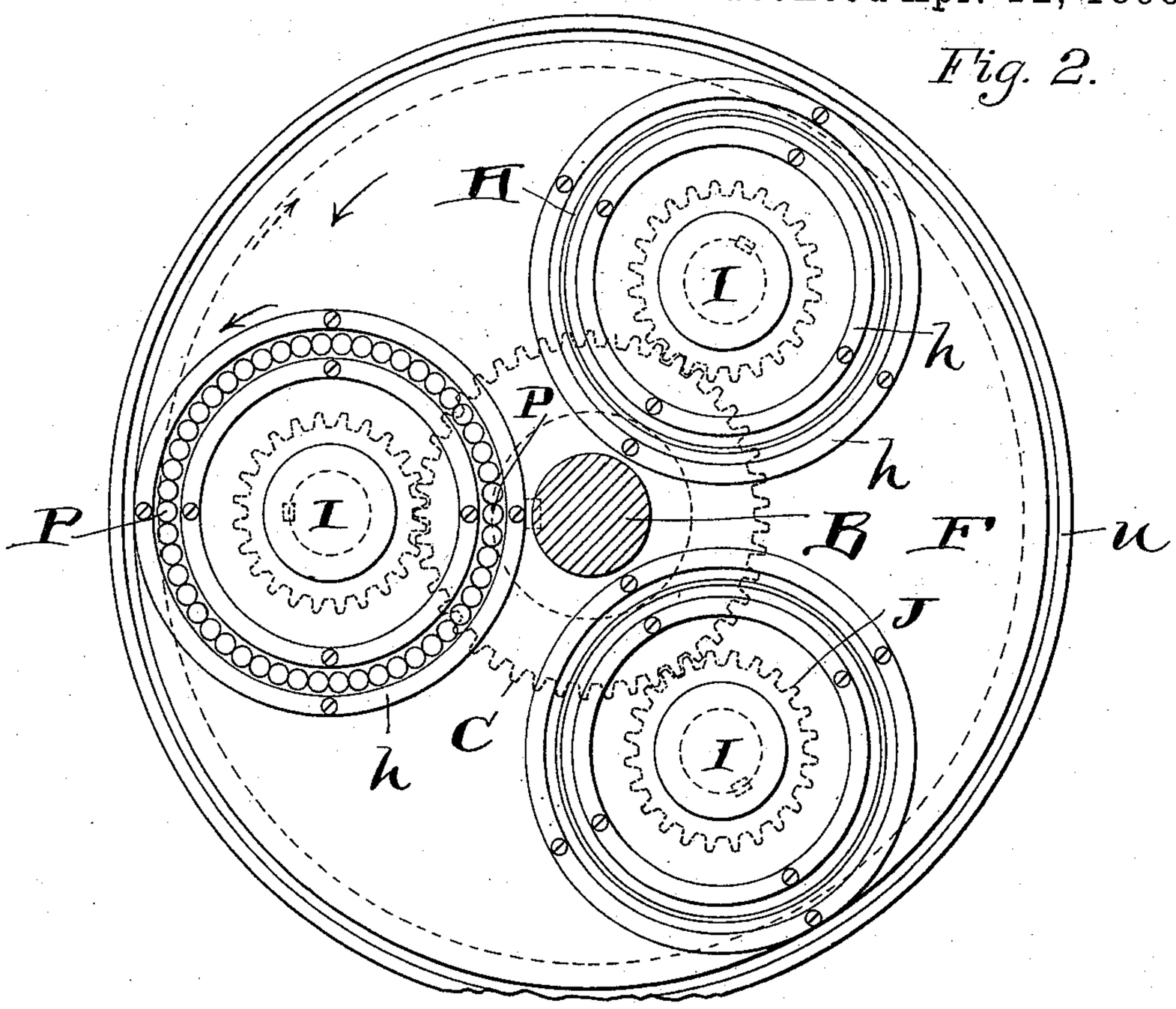
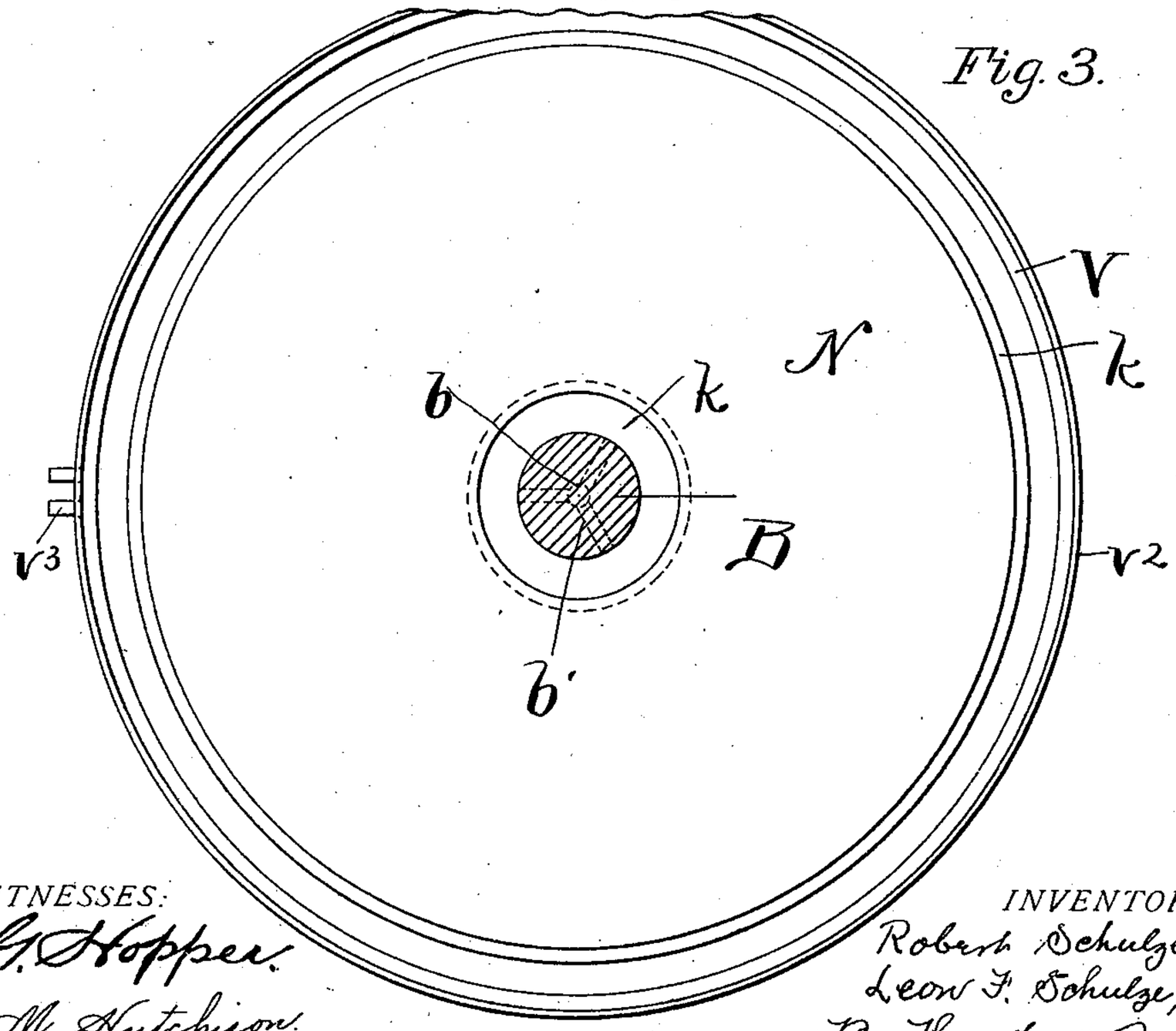


Fig. 3.



WITNESSES:
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UNITED STATES PATENT OFFICE.

ROBERT SCHULZE AND LEON F. SCHULZE, OF CLEVELAND, OHIO, ASSIGNORS TO FREDERICK SCHULZE, OF SAME PLACE.

BALL-GRINDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 602,365, dated April 12, 1898.

Application filed June 24, 1897. Serial No. 642,077. (No model.)

To all whom it may concern:

Be it known that we, ROBERT SCHULZE and LEON F. SCHULZE, citizens of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Ball-Grinding Machines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The object of our invention is to provide a simple and efficient machine for grinding metal balls in which the surface of the grinding material shall be evenly worn and the balls truly ground and the resulting waste material conveniently removed.

The invention consists, primarily, of a rotary body carrying a plurality of ball-races each having an individual rotation, combined with a grinding-surface which contacts with the balls in such races and rotates independently of each of the prior-mentioned rotations.

Another part of the invention consists in placing a casing around the grinding and ball rotating parts and supplying entrance and exit orifices thereto in such position that a blast of air or a stream of water may effectively carry away the waste products of the grinding.

The combinations of parts hereinafter described, and definitely enumerated in the claims, also specify wherein the invention consists.

The drawings clearly show our invention. Figure 1 is a side elevation, partly in section, of the same. Figs. 2 and 3 are each horizontal sections on the line $x\,x$ of Fig. 1, the former looking downward and the latter looking upward, as indicated by the numbered arrows on said line.

Referring to the parts by letters, A represents the frame of the machine, consisting of an upright standard and two horizontal arms a and a'. Extending vertically through these arms and journaled in the arm a' is the shaft B. Loosely surrounding this shaft and rigidly secured to a boss a^2 on the upper side of the arm a' is a gear C. A collar D is secured to the shaft B above this gear and prevents such shaft from descending. Beneath the arm a' is a pulley E, which is rigidly secured to the shaft B and drives the same. The shaft B is thus prevented from moving longitudinally through the arm a', but is adapted to rotate therein.

Secured to the shaft B above the collar D is a disk F. A plurality of smaller disks G, carrying ball-races H, are revolubly secured to this disk F by means of the shafts I, which are keyed to said disks G and journaled in said disk F. To the lower ends of these shafts I are secured gear-pinions J, which mesh with the stationary gear-wheel C. It is thus apparent that a rotation of the shaft B not only causes the disk F to rotate, but causes all of the smaller disks G to rotate about their own centers while being carried around the shaft B by the disk F. A flange f extends downward from the periphery of the disk F and acts as a dust-cap for the gears.

Loosely journaled in the arm a is the sleeve K, which loosely surrounds the shaft B and which carries at its lower end the disk k and is limited in its downward movement by the collar M, which screws onto the sleeve and is therefore adjustably secured to it. A set-screw m locks the collar M after it is adjusted.

Clamped to the lower surface of the disk k by suitable means is the annular grinding-ring N. This ring is made of emery or other suitable material, is of the proper thickness to do a large amount of grinding, and is of a width (in a radial direction across one portion of the ring) just equal to the distance from a central point in a ball-race H to a central point diametrically opposite. The ball-races are composed of two steel rings h, secured to the disks G. These rings have their opposing faces beveled, thereby leaving an approximately V-shaped groove between them. In this groove the balls roll, the drawings showing said balls at P in one of the races. The highest point of the outermost ball in any race is therefore just in contact with the outer corner of the grinding-ring, while the innermost ball is in contact with the inner corner, as is shown in the left-hand race in Fig. 1.

Rigidly secured to the top of the sleeve K is the pulley Q, by which the same is driven. The shaft B, which projects upward above this pulley, has screwed onto it near its upper

end the collar R, and between this collar and a washer S, which loosely surrounds said shaft and bears upon the upper surface of the pulley Q, is a helical spring T. This spring, which is adjusted in its force by the said collar R, (which after adjustment is locked by the set-screw *r*,) forces the sleeve K downward and thus causes the grinding-ring N to bear upon the balls with the desired force.

A two-part casing incloses the ball rotating and grinding parts. The lower part of this casing, consisting of a circular plate U and a vertical cylindrical wall *u*, is stationarily secured to the arm *a'* of the frame and incloses the bottom and sides of the ball-rotating parts. Coöperating with this lower part is an upper part V, which incloses the top and sides of the grinding-ring. This upper part rests on a gasket W on the upper edge of the wall *u* and has a depending flange *v*, which closely embraces the exterior of said wall. The gasket and flange enable the connection between the two parts of the casing to be approximately air-tight. This upper portion of the casing surrounds the sleeve K as tightly as may be without undue friction and has extending along the sleeve K the short sleeve *v'*, in which there is annular recess v^2. A pin *k'* extends from the sleeve K into this annular recess, whereby if the sleeve K is elevated the pin *k'* contacts with the upper portion of the sleeve *v'* and raises the upper portion of the casing. This upper portion is prevented from rotating by any suitable means, that shown consisting of a pin a^3, projecting from the vertical standard of the frame between a pair of lugs v^3 on said upper portion.

A vertical tubular hole *b* extends downward through the shaft B from its upper end to a point opposite the upper surface of the balls in the races and at this point branches into as many horizontal pipes *b'* as there are ball-races H. From the upper end of the shaft B extends a pipe b^2, by which a blast of air or a stream of water may be conveyed to the tubular hole *b* and from thence to the balls and grinding-surface. An exit-pipe *u'* is provided at or near the bottom of the casing. A suction-pump is preferably connected with this pipe, whereby the water or air coming in through the pipe b^2 is effectively withdrawn, charged with the dust and waste material caused by the grinding of the balls.

In operation the set-screw *r* is loosened and the collar R screwed upward, thereby loosening the spring, and then the sleeve K, with its disk and grinding-ring, and the upper casing V are elevated sufficiently to allow the races to be filled with balls. The grinding-ring N is then allowed to descend upon the balls and the upper casing upon the gasket W and the collar R screwed down until the desired pressure of the grinding-ring upon the balls is obtained, when the collar is locked. The machine is then set in operation, the pulley E and the pulley Q, being revolved in opposite directions and being of different size, revolving their respectively-attached parts at different speeds. The revolution of the disk F gives a circular translation of the ball-races and also, by means of the shaft I and gears J, causes their independent rotation, which rotation at the other edge of the disk G is in the same direction as that of the disk F, while at the inner edges is in the opposite direction.

It will thus be seen that each set of balls as a whole is drawn circularly around the grinding-surface in the opposite direction to which that surface is driven, while at the same time the balls individually travel in a circular path from one edge of that of the grinding-surface to the other. The result of the combinations of this motion is that the balls are ground on every face, and hence are perfect spheres at the end of the operation, while the grinding-surface is kept true and even by the balls traveling from one edge thereof to the other. Meanwhile the pressure of air or water supplied to the pipe b^2 and the suction on the pipe *u'* cause the waste particles of the grinding to be removed as fast as produced.

As the grinding-surface wears away the sleeve K and the disk *k* descend, and the adjustment of the spring T is changed as necessary. The recess v^2 in the sleeve *v'* is long enough not to interfere with the descension of the sleeve K until the available grinding-surface has been worn away.

Having described our invention, we claim—

1. In a machine for grinding spherical balls, in combination, a rotating disk, a plurality of smaller disks carried by said first-mentioned disk and independently rotatable thereon, said smaller disks being adapted to carry balls to be ground, and a grinding-wheel adapted to contact with balls so carried, substantially as described.

2. In a machine for grinding spherical balls, a rotating disk F, a plurality of smaller disks G supported by said disk F and compelled to rotate therewith, means for giving said smaller disks an independent rotation about their own axes, and ball-races H carried by said smaller disks, in combination with a grinding-surface adapted to contact with balls in said races, substantially as described.

3. In a machine for grinding spherical balls, in combination, a disk F, means for rotating the same, a plurality of smaller disks supported by said disk and carried by it and also independently rotatable thereon, means for causing said independent rotation when said disk F rotates, ball-races carried by said smaller disks, a grinding-surface adapted to contact with balls in said races, and means for rotating said surface in the opposite direction to the rotation of the disk F, substantially as described.

4. In a machine for grinding spherical balls, a frame, a shaft B journaled therein, a disk F

carried by said shaft B, a plurality of smaller disks carried by said disk F and adapted to carry balls, said smaller disks having axial shafts I journaled in said disk F, a stationary gear C, a gear J on each of said shafts I in mesh with said gear C, in combination with a grinding-surface adapted to contact with balls carried by said disks G, substantially as described.

5. In a machine for grinding spherical balls, in combination, a rotatable disk F, smaller disks G carried thereby, but adapted to rotate on their own axes, ball-races on said disks G, a rotating disk *k* carrying grinding material adapted to contact with balls in said races, the said disk *k* having the capacity for axial movement, and a stop for limiting said movement in the direction toward the ball-races, substantially as described.

6. In a machine for grinding spherical balls, in combination, a frame, a shaft B journaled therein, a disk F secured to said shaft, a plurality of smaller disks carried by said disk F and adapted to rotate about their own axes, ball-races on said smaller disks, a sleeve K surrounding said shaft B and journaled in said frame and capable of longitudinal movement through the same, a disk *k* secured to said sleeve and having a grinding-surface adapted to contact with the balls in said races, and a collar on said sleeve adapted to limit the movement of said disk in the direction toward said races, substantially as described.

7. In a machine for grinding spherical balls, in combination, a plurality of circular ball-races, means for causing the same to revolve about their centers, and means for giving the ball-races as a whole a circular translation, a grinding-ring adapted to contact with balls in said races, the outer corner of said grinding-ring being in contact with the highest point of the outermost balls in said races, and the inner corner being in contact with the highest point of the innermost balls in said races, substantially as described.

8. In a machine for grinding spherical balls, in combination, a plurality of circular ball-races, means for causing the same to revolve about their centers and means for giving the ball-races as a whole a circular translation, a grinding-ring adapted to contact with balls in said races, the outer corner of said grinding-ring being in contact with the highest point of the outermost balls in said races, and the inner corner being in contact with the highest point of the innermost balls in said races, and means for rotating said grinding-ring and for pressing the same against said balls, substantially as described.

9. In a machine for grinding spherical balls, in combination, a frame, a shaft B journaled therein, means carried by said shaft for supporting a plurality of circular ball-races and giving them rotation about their centers, and a circular translation about the axis of said shaft B, a sleeve K journaled in said frame and surrounding said shaft B, and grinding material connected with said sleeve K adapted to contact with balls in said races, means for rotating said sleeve, and a spring compressed between said sleeve, and an adjustable collar R on said shaft B, substantially as described.

10. In a machine for grinding spherical balls, in combination, a frame, a shaft B journaled therein, means carried by said shaft for supporting balls to be ground, a sleeve K surrounding said shaft B and journaled in said frame, a disk secured to said sleeve and carrying grinding material adapted to contact with said balls, said sleeve and grinding material being capable of movement toward or from said balls, a collar on said sleeve limiting its movement toward said balls, a collar R on said shaft B, and a spring T compressed between said collar and said sleeve and thereby pressing the grinding material toward said balls, substantially as described.

11. In a machine for grinding spherical balls, in combination, a frame, a shaft B journaled therein, means for rotating said shaft, a disk F carried by said shaft, a plurality of smaller disks G supported by said disk F and adapted to carry balls, shafts I axially secured to said disks G and journaled in said disk F, a stationary gear C surrounding said shaft B and secured to the frame, gears J secured to said shafts I and meshing with said gear C, a sleeve K journaled in the frame and surrounding the shaft B, a grinding-ring N adapted to contact with balls carried by the disks G, means for securing said grinding-ring to the sleeve K, said sleeve being capable of movement toward or from the balls being ground, a collar on said sleeve limiting its movement toward said balls, and a spring pressing said sleeve toward said balls, substantially as described.

12. In combination, with a machine for grinding spherical balls, having ball rotating and grinding parts, of a casing surrounding said parts, and an entrance-pipe and an exit-pipe communicating with the interior of said casing, substantially as described.

13. In a machine for grinding spherical balls, in combination, a frame, a shaft journaled therein, means carried by said shaft for supporting balls and causing them to travel, a grinding-ring surrounding said shaft and adapted to contact with balls so carried, there being a tubular hole in said shaft having its exit near the balls so carried, a pipe or tube connected with said tubular hole, a casing surrounding said ball-supporting parts and said grinding-ring, and a tube or pipe communicating with the interior thereof, substantially as described.

14. In a machine for grinding spherical balls, in combination, a frame, a shaft B journaled therein, means carried by said shaft for supporting a plurality of circular ball-races, a grinding-ring surrounding said shaft and adapted to contact with balls in said races, a two-part stationary casing inclosing

said ball rotating and grinding parts, said casing being separable upon a line near said ball-races, a tubular hole in said shaft B having its exit near said ball-races, a pipe or tube connected with said hole, and a pipe or tube connected with said casing, substantially as described.

15. In a ball-grinding machine, in combination, a frame, a shaft B journaled therein, ball-rotating mechanism carried by said shaft, one part of a stationary casing surrounding said ball-rotating mechanism and supported by said frame, a grinding-ring surrounding said shaft B and adapted to contact with balls carried by the ball-rotating mechanism and capable of movement toward and from said balls, a second part of said casing surrounding said ball-grinding ring and engaging with said first part, means for preventing the rotation of said second part and means whereby movement of said grinding-ring and its attached parts from said balls may compel said second part to move with them and thereby separate the two parts of the casing, and an entrance and an exit to said casing for allowing an in-and-out passage of fluid, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

ROBERT SCHULZE.
LEON F. SCHULZE.

Witnesses:
ALBERT H. BATES,
E. B. GILCHRIST.