No. 609,219. Patented Aug. 16, 1898.

R. H. WHITE.

BALL GRINDING MACHINE.

(Application filed July 14, 1897.)

(No Model.) 3 Sheets—Sheet 1.

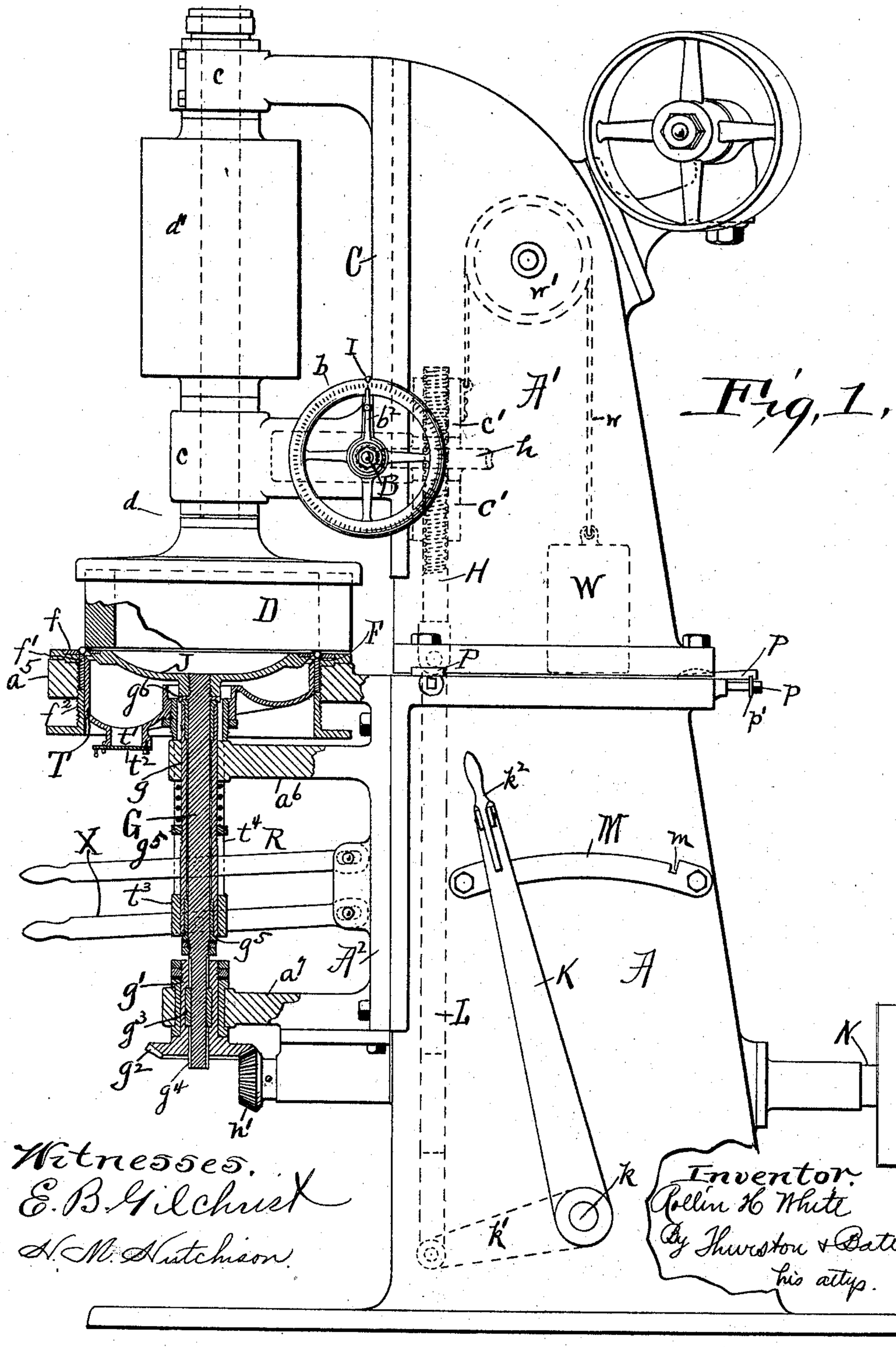

Fig. 1.

Witnesses.
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A. M. Hutchison.

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Fig. 2

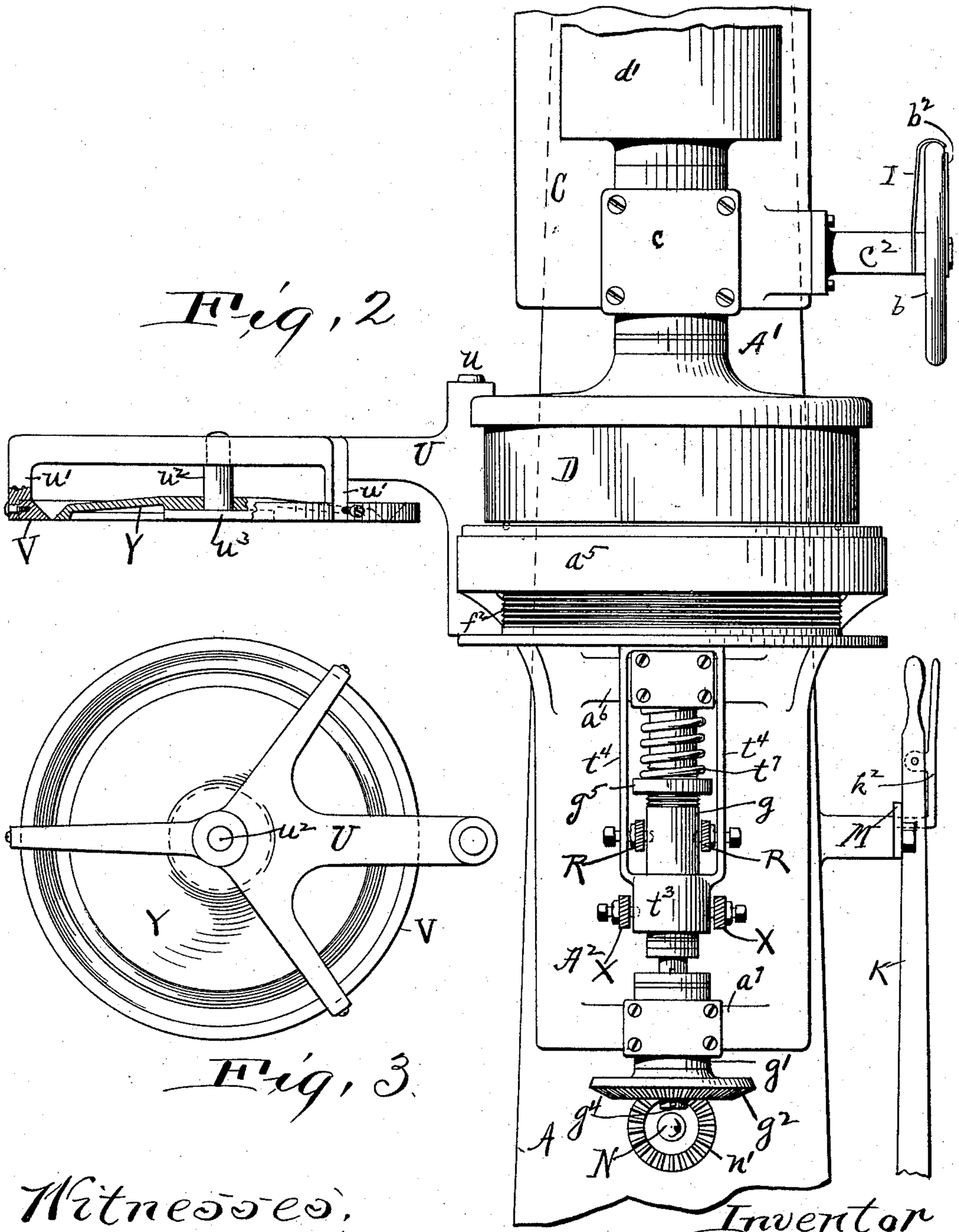

Fig. 3.

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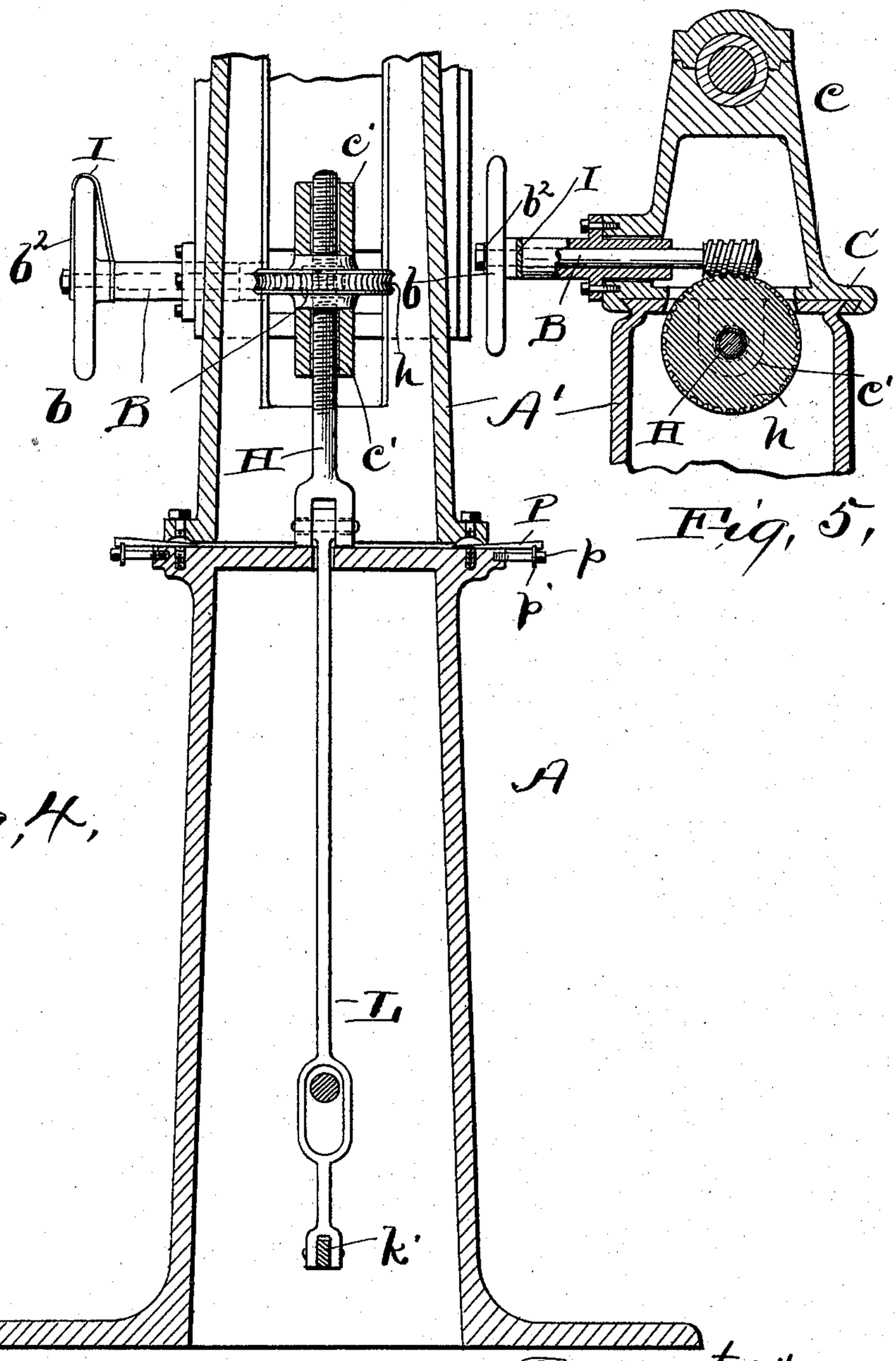

Fig. 5.

Fig. 4.

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UNITED STATES PATENT OFFICE.

ROLLIN H. WHITE, OF CLEVELAND, OHIO.

BALL-GRINDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 609,219, dated August 16, 1898.

Application filed July 14, 1897. Serial No. 644,498. (No model.)

To all whom it may concern:

Be it known that I, ROLLIN H. WHITE, a citizen 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 I 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.

My invention has for its objects to grind balls into true spheres of the desired size and to provide means whereby the ground balls may be quickly removed and a fresh supply to be ground introduced into the machine.

The invention consists in the construction and combination of parts hereinafter described and claimed.

In the drawings, Figure 1 is a side elevation, partly in section. Fig. 2 is a front view of a part of the machine. Fig. 3 is a plan view of the loader. Fig. 4 is a vertical sectional view of the machine through the adjusting-screw H, looking toward the front of the machine. Fig. 5 is a horizontal sectional view on the plane indicated by line 5 of Fig. 4.

The frame of the machine consists, as shown, of a base A, an upper member A′, which is bolted on the base, and a casting A^2, which is bolted to the front side of the base. This is a convenient and economical construction, but the frame may be of any suitable construction.

A vertically-movable slide C is mounted in guides on the front face of the upper frame member. Two horizontal arms *c c*, which project forward from said slide, furnish bearings for a vertical grinder-shaft *d*. The cylindrical grinder D is secured to the lower end of this shaft in any suitable manner, and a driving-pulley *d′* is secured to the shaft between said arms *c c*. On the rear side of the slide are two horizontal arms *c′ c′*, between which lies a nut *h*. This nut screws onto a threaded rod H, which rod passes through perforations in said arm *c′ c′*. The slide is supported by the rod H, and when the slide is in the lowest position the lower end of this rod is preferably supported upon the frame.

A horizontal worm-shaft B is mounted in a sleeve c^2, formed upon the slide C. It engages with worm-teeth formed upon the periphery of the nut *h*. A hand-wheel *b* is secured to the shaft B, whereby it may be turned, with the result of raising or lowering the slide without moving the threaded rod. This affords means for nicely adjusting the position of the slide, and consequently of the grinder, relative to the balls.

K represents a lever-arm which is rigidly secured to a rock-shaft *k*, and to this rock-shaft an arm *k′* is rigidly secured. This lever-arm is connected, by means of a link L, with the lower end of the threaded rod H, these two parts being pivoted together. Obviously by moving the lever K to the right, as shown in Fig. 1, the slide C is raised. A counterweight W, attached to a rope *w*, assists in lifting the slide, because said rope passes over a sheave *w′* and is secured to the upper bracket-arm *c*. The lever K may be secured at either of these two extreme positions by a latch k^2, which engages with notches *m* in a segment-bar M, secured to the side of the base of the machine.

If the parts described furnished the sole support for the slide C, the bending of the lever K or lever-arm *k′* or of the link L would cause a variation in the height of the lower face of the grinder D, which obviously is undesirable. Therefore the pivot between link L and threaded rod H fits loosely the holes which receive it, and this allows the lower end of the threaded rod to rest, as before explained, upon the frame when the slide C is lowered.

The hand-wheel *b* is graduated to coöperate with the pointer I, which is secured to the sleeve c^2. A second pointer b^2 is clamped to the hand-wheel by the same nut which holds the hand-wheel upon the shaft B. This pointer b^2 may at the beginning of a grinding operation be set in line with a pointer I. Thereafter it will move with the hand-wheel, and therefore show how far said hand-wheel has been moved from the position it originally occupied when the grinding operation began.

It is obviously necessary that the grinding-face of the grinder shall always remain in a

horizontal position, and it is therefore desirable to provide means for adjusting the mechanism so that this condition may be brought about and maintained at all times. The means provided consist of three wedges placed between the meeting faces of the base A and upper frame member A′, said wedges P being placed, respectively, at the sides and near the front of said meeting faces and at the rear thereof. These wedges are moved in or out by means of the bolts P, having the flanges p', which enter corresponding notches in the wedges.

The bed-plate a^5 and the two horizontal bracket-arms a^6 a^7 are parts of the frame member A^2. In the bed-plate a circular opening is formed, around the upper edge of which a flat ring f, of hardened metal, is set. A hardened-metal sleeve f' is fitted in said opening and is vertically movable therein. The upper edge of this sleeve, which is slightly inclined downward from its outer periphery, and the inner edge of the ring f form the raceway F, in which the balls to be ground are held. It should be here stated that this circular opening and raceway are eccentric to the axis of the grinder.

f^2 represents an adjusting-sleeve which is externally threaded and screws into said circular opening in the bed-plate from the lower end thereof, and the function of this sleeve is to adjust the position of the sleeve f' to compensate for wear.

Sleeves g g' are respectively mounted in the two arms a^6 a^7, and a shaft G is mounted in these sleeves, this shaft being concentric with the ball-raceway, and consequently eccentric with the grinder. The revolver J is secured to the upper end of this shaft. Its form is that of an inverted truncated cone—that is to say, its periphery is beveled from the top inward, as shown—and its functions are to hold the balls in the raceway while they are being ground and to move them around therein during the grinding operation. Its diameter and position are such that it touches the balls in the raceway F just above their centers.

A bevel-gear g^2 is secured to the sleeve g'. A bevel-gear n' is secured to the driven shaft N, whereby the sleeve g' is revolved. This sleeve is provided with tongues g^3, which enter grooves g^4 in the shaft G, whereby the shaft is compelled to revolve with the sleeve, but is permitted to move vertically therein. Shoulders g^5 and g^6 on the shaft G lie, respectively, below and above the ends of the sleeve g, wherefore the vertical movement of said sleeve, whether up or down, correspondingly moves the shaft. This sleeve is moved up and down by means of a fork-lever R, which is pivoted to the frame member A^2 and is pivoted to said sleeve g.

T represents a cylinder which fits and is adapted to slide in the sleeves f' and f^2. This cylinder has a recess in its upper end, the bottom of which recess is inclined toward the opening t' therein, which may be closed by a swinging valve t^2. The sleeve and its bottom form a receiver into which the finished balls are discharged. The upper edge of this cylinder while the balls are being ground lies just below the raceway. The cylinder T loosely embraces the sleeve g and rests upon the upper arm a^6. A collar t^3 surrounds and is vertically movable upon the sleeve g, and this collar is rigidly connected by two arms t^4 with cylinder T. A lever X, which is pivoted to the frame member A^2, is also pivotally connected with this collar t^3, whereby said sleeve may be raised.

U represents a horizontal arm which is pivoted on a vertical pivot u to the side of the frame of the machine. Depending feet u' support a ring V, the inner periphery of which is beveled outward from its lower side. Y represents a plate which is loosely mounted upon a vertical stud u^2, which is secured to the arm U, said stud having a flange u^3 in its lower end which limits the downward movement of said plate Y. The outer periphery of this plate Y is slightly beveled inward from its lower edge, and when this plate rests upon the flange u^3 it, together with the ring Y, forms an annular V-shaped groove. This ring and plate constitute the loader—that is to say, the device whereby the ball-race F may be quickly filled with balls.

The operation of the described mechanism is as follows: When the balls are in the race-way, the shaft G, and consequently the revolver J, is rotated, thereby causing the balls to move around in the raceway. At the same time the eccentrically-set grinder is rotated in contact with the balls. It is evident that the balls will be rotated by these instrumentalities in such manner as to sooner or later bring all parts of the balls in contact with the grinder, wherefore each ball will be ground into a true spherical form. When this operation has been completed, the slide C, and with it the grinder D, is raised by the action of the lever K. Then the revolver J is raised by the operation of the lever R, and this permits the balls just ground to fall down into the recess in the cylinder T, from which they may be removed through the opening t'. The groove formed between the ring V and plate Y is filled with balls, this operation being performed while the first series of balls is being ground. When the grinder has been raised, the arm U is turned upon its pivot until the loader-groove in which the balls have been placed is directly over the raceway F. Then by the operation of the lever X the cylinder T is raised, whereby it becomes temporarily an inner wall to the raceway F. The further upward movement of this cylinder brings it into engagement with the revolver J, which is raised. The revolver engages with and raises the plate Y, thereby allowing the balls in the loader-groove to fall into the race-

way F. When the lever X is lowered, all of these parts reverse their movement and return to the position shown in Fig. 1 in coming into contact with the balls just introduced into said raceway. The sleeve *g* may be drawn down by a spring t^7, which embraces the sleeve *g* and thrusts against the arm a^6 and a nut g^5 on the sleeve *g*, connecting the bars *t*. The slide C is then lowered until the grinder engages with the balls and the operations are repeated.

From the foregoing description it is clear that it is the relative movement vertically of the raceway F and revolver J which causes the release of the finished balls and that it is not essential to the invention, broadly considered, which of these two parts so moves. So it is the relative movement of the raceway and cylinder T which is necessary to close the inner periphery of the raceway, and it is the relative movement of the ring and plate of the loader which is necessary to release the balls from the loader-groove. I do not, therefore, intend to limit the invention to a construction wherein the raceway is vertically immovable except as clearly indicated in the claims.

Having described my invention, I claim—

1. In a ball-grinding machine, in combination, a non-rotating circular raceway open at its inner periphery, a rotating revolver in the form of an inverted frustum of a cone which is inside of and concentric with the said raceway, the periphery of said revolver being adapted to bear upon the balls in the raceway, whereby it moves the balls around said raceway, and prevents their escape therefrom, and a grinder which bears upon the balls in the raceway, substantially as specified.

2. In a ball-grinding machine, in combination, a non-rotating circular raceway open at its inner periphery, a rotating revolver in the form of an inverted frustum of a cone, which is inside of and concentric with the said raceway, the periphery of said revolver being adapted to bear upon the balls in the raceway, whereby it moves the balls around said raceway, and prevents their escape therefrom, an eccentric rotary grinder, and mechanism for moving said grinder and revolver upward relative to the raceway, substantially as specified.

3. In a ball-grinding machine, in combination, a circular raceway open on its inner periphery, a revolver in the form of an inverted frustum of a cone, the periphery of which is adapted to bear upon the balls in the raceway, a cylinder concentric with and inside of, but normally below said raceway, a rotary grinder and mechanism for moving the grinder, cylinder and revolver upward relative to the raceway, whereby, first, the revolver releases the balls from said raceway, and the cylinder then forms a temporary inner periphery for the raceway, substantially as specified.

4. In a ball-grinding machine, in combination, a raceway open at its inner periphery, a revolver inside of and concentric with said raceway, which revolver is in the form of an inverted frustum of a cone, and is adapted to bear upon the balls in the raceway to hold and move them therein, a hollow cylinder concentric with and inside of said raceway, but normally below the same, which cylinder has a bottom, an eccentric rotary grinder adapted to bear upon the balls in the raceway, mechanism for moving the grinder, revolver and hollow cylinder upward relative to the raceway, for the purpose of first releasing the balls from the raceway, and allowing them to fall in said hollow cylinder, and then to cause said hollow cylinder to temporarily close the inner periphery of the raceway, whereby said raceway may be loaded with balls, substantially as specified.

5. In a ball-grinding machine, in combination, a circular raceway open on its inner periphery, means for holding the balls in said raceway and moving them around therein during the grinding operation, a grinder adapted to bear upon the tops of the balls in said raceway, and a cylindrical receiver movable upward relative to said raceway, which receiver is inside of and concentric with said raceway and normally below the same, said receiver being adapted to catch the balls which are released from said raceway, and is also adapted to form a temporary inner wall for the raceway when the same is being loaded with balls, substantially as specified.

6. In a ball-grinding machine, in combination, a circular raceway having an outer wall and a slightly-inclined bottom, a revolver, a cylinder inside and below the raceway, mechanism for raising the said revolver and cylinder relatively to the raceway, and a loader having a circular ball-groove of substantially the same diameter as the raceway and adapted to drop the balls from said groove into the raceway, substantially as specified.

7. In a ball-grinding machine, in combination, a circular raceway having an outer wall and a slightly-inclined bottom, a revolver, a cylinder inside and below the raceway, mechanism for raising the said revolver and cylinder relatively to the raceway, and a loader consisting of a ring having a beveled inner periphery, and an inner plate which is movable vertically relatively to said ring, substantially as specified.

8. In a ball-grinding machine, in combination, a circular raceway, a vertically-movable revolver, a vertically-movable cylinder inside the raceway and below it and the revolver, a loader consisting of an outer ring and an inner vertically-movable plate, means for holding the loader over the ball-raceway, and mechanism for raising the said cylinder, revolver and inner loader-plate, substantially as specified.

9. In a ball-grinding machine, in combination, a circular raceway, a vertically-movable revolver, a vertically-movable cylinder inside

the raceway and below it and the revolver, a loader consisting of an outer ring and an inner vertically-movable plate, a pivoted arm carrying the loader, and adapted to be swung to bring the loader over the raceway, and mechanism for raising said cylinder, revolver and inner loader-plate, substantially as specified.

10. In a ball-grinding machine, a loader consisting of a ring having a beveled inner periphery and an inner plate which is movable vertically ralative to said ring, whereby balls in the annular groove formed between said plate and ring may fall out of the bottom of said groove, substantially as specified.

11. In a ball-grinding machine, in combination, a vertically-movable grinder, an annular ball-raceway, a horizontal swinging arm pivoted to the frame of said machine, and a loader carried by said arm consisting of a ring having a beveled inner periphery and an inner plate which is movable vertically relative to said ring, whereby balls in the groove formed between said ring and plate may be permitted to fall out of the bottom of said groove into said raceway, substantially as specified.

12. In a ball-grinding machine, the combination of a ball-raceway, an eccentric grinder, means for moving the grinder vertically, a horizontal swinging arm, a loader-ring secured to said arm, a vertical central stud having a flange on its lower end, and an inner lower plate vertically movable upon said stud, substantially as specified.

13. In a ball-grinding machine, the combination of a vertically-movable grinder, a fixed ball-raceway eccentric thereto, a revolver which is attached to a vertically-movable shaft, a vertically-movable sleeve embracing said shaft, a cylinder within the ball-raceway and below the revolver which loosely embraces said shaft, a collar embracing said sleeve, rigid connection between said cylinder and collar, a swinging horizontal arm, a loader carried thereby consisting of a fixed outer ring having a beveled inner periphery, and a vertically-movable inner plate, and means for raising said collar, whereby the cylinder is raised and caused to form a temporary inner wall for the raceway, the revolver is raised and the inner plate of the loader is raised, whereby balls in the loader-groove fall out of the bottom of the same into the ball-raceway, substantially as specified.

14. In a ball-grinding machine, a circular raceway, a rotary grinder eccentric thereto, a vertically-movable slide which supports said grinder, a vertically-movable rod, and means for supporting and operating the same, and adjustable connections between said rod and slide, substantially as specified.

15. In a ball-grinding machine, in combination, a circular ball-raceway, a rotary grinder eccentric thereto, a vertically-movable slide which supports the grinder-shaft, a vertically-movable threaded rod, and means for moving and supporting the same, and an adjusting-nut which connects said rod and slide, substantially as specified.

16. In a ball-grinding machine, in combination, a circular ball-raceway, a rotary grinder eccentric thereto, a vertically-movable slide which supports the grinder-shaft, a vertically-movable threaded rod, an operating-lever, mechanism connecting the same with said threaded rod, a fixed support for the lower end of said rod, and adjustable connections between said rod and slide, substantially as specified.

17. In a ball-grinding machine, in combination, a circular ball-raceway, a rotary grinder eccentric thereto, a vertically-movable slide which supports the grinder-shaft, a vertically-movable threaded rod and means for moving the same, and an adjusting-nut which connects said rod and slide, an operating-lever, mechanism connecting the same with said threaded rod, a fixed support for the lower end of said rod, an adjustable worm-nut which connects said threaded rod and slide, and a worm-shaft mounted on the slide for turning said nut, substantially as specified.

18. In a ball-grinding machine, in combination, a circular ball-raceway, a rotary grinder eccentric thereto, a vertically-movable slide which supports the grinder-shaft, a vertically-movable threaded rod and means for moving the same, and an adjusting-nut which connects said rod and slide, an operating-lever, mechanism connecting the same with said threaded rod, a fixed support for the lower end of said rod, an adjustable worm-nut which connects said threaded rod and slide, and a worm-shaft mounted on the slide for turning said nut, a graduated hand-wheel secured to said shaft and a pointer secured to the slide, substantially as specified.

19. In a ball-grinding machine, in combination, a base which supports the ball-raceway, an upper frame member which supports the grinder and is bolted to the base, three adjusting-wedges interposed between the base and upper frame member, and means for operating said wedges, substantially as specified.

20. In a ball-grinding machine, the combination of an endless ball-raceway, and a rotating grinder for grinding the balls therein, said raceway and grinder being capable of relative vertical movement toward and from each other, with a loader having a groove of the same size and shape as the ball-raceway and adapted to contain balls to be ground, and means for releasing said balls through the bottom of said groove, substantially as and for the purpose specified.

21. In a ball-grinding machine, the combination of an endless ball-raceway, and a rotating grinder for grinding balls therein, said raceway and grinder being capable of relative vertical movement toward and from each

other, with a loader consisting of an inner plate having externally the configuration of said ball-raceway, and an outer plate having a central opening of larger size but of the same shape, whereby a groove is formed between said plates of the same size and shape as said ball-raceway, and means for releasing through the bottom of said groove, balls placed therein, substantially as and for the purpose specified.

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

ROLLIN H. WHITE.

Witnesses:
E. L. THURSTON,
ALBERT H. BATES.