

(No Model.)

4 Sheets—Sheet 1.

R. H. GRANT.  
GRINDING MACHINE.

No. 520,019.

Patented May 15, 1894.

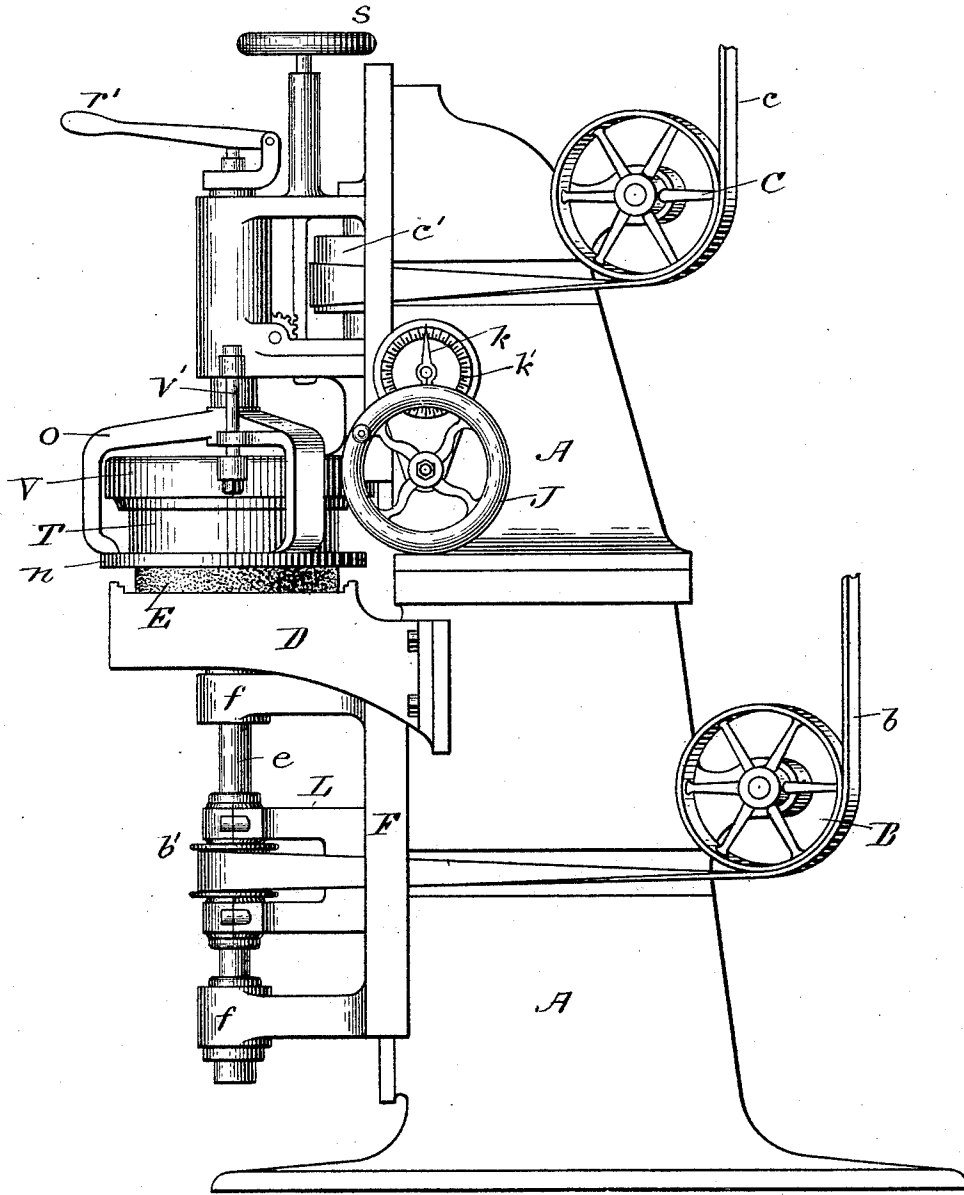


Fig. 1.

WITNESSES  
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*L. G. Hawcette.*

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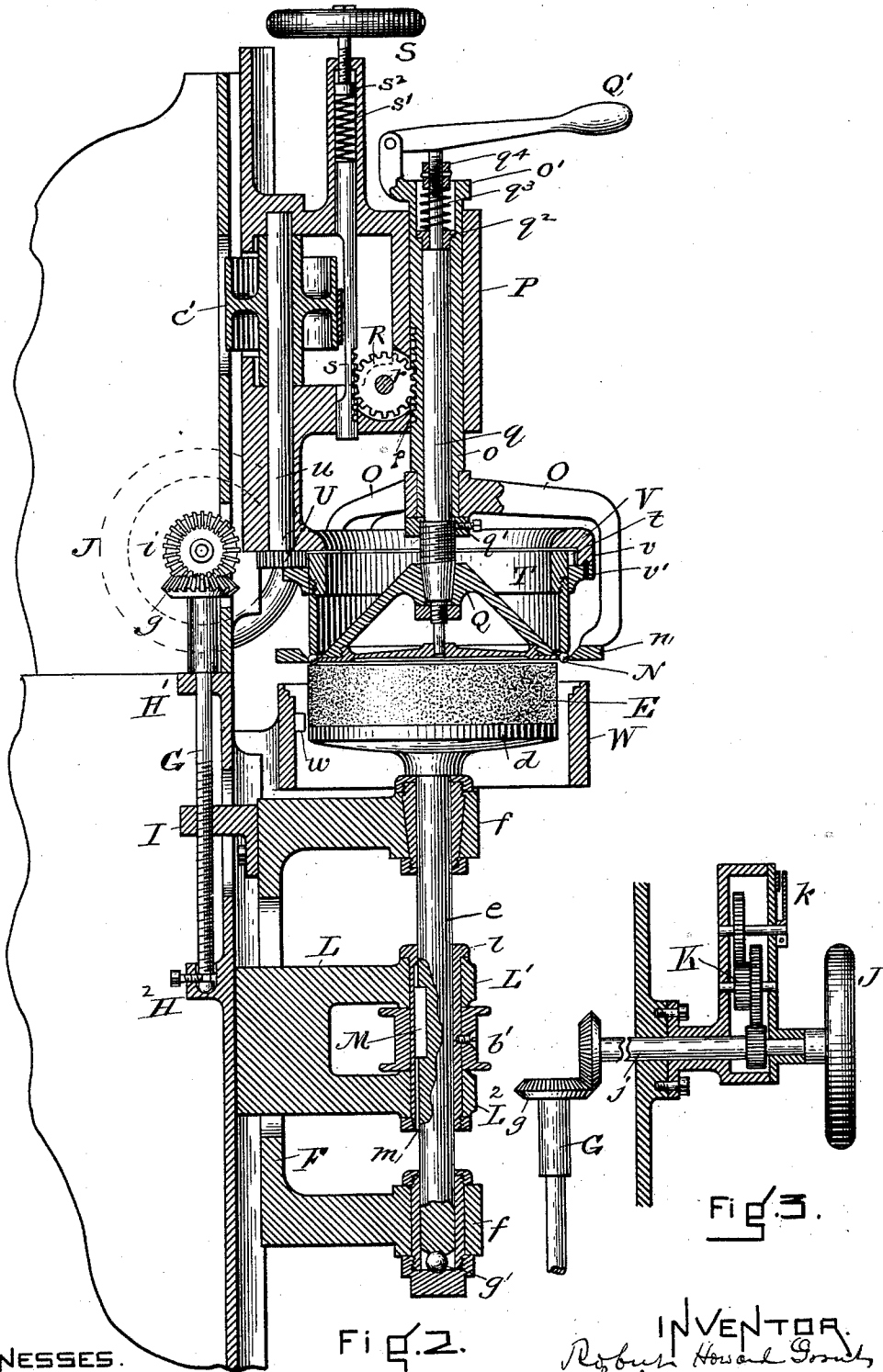


Fig. 2.

Fig. 3.

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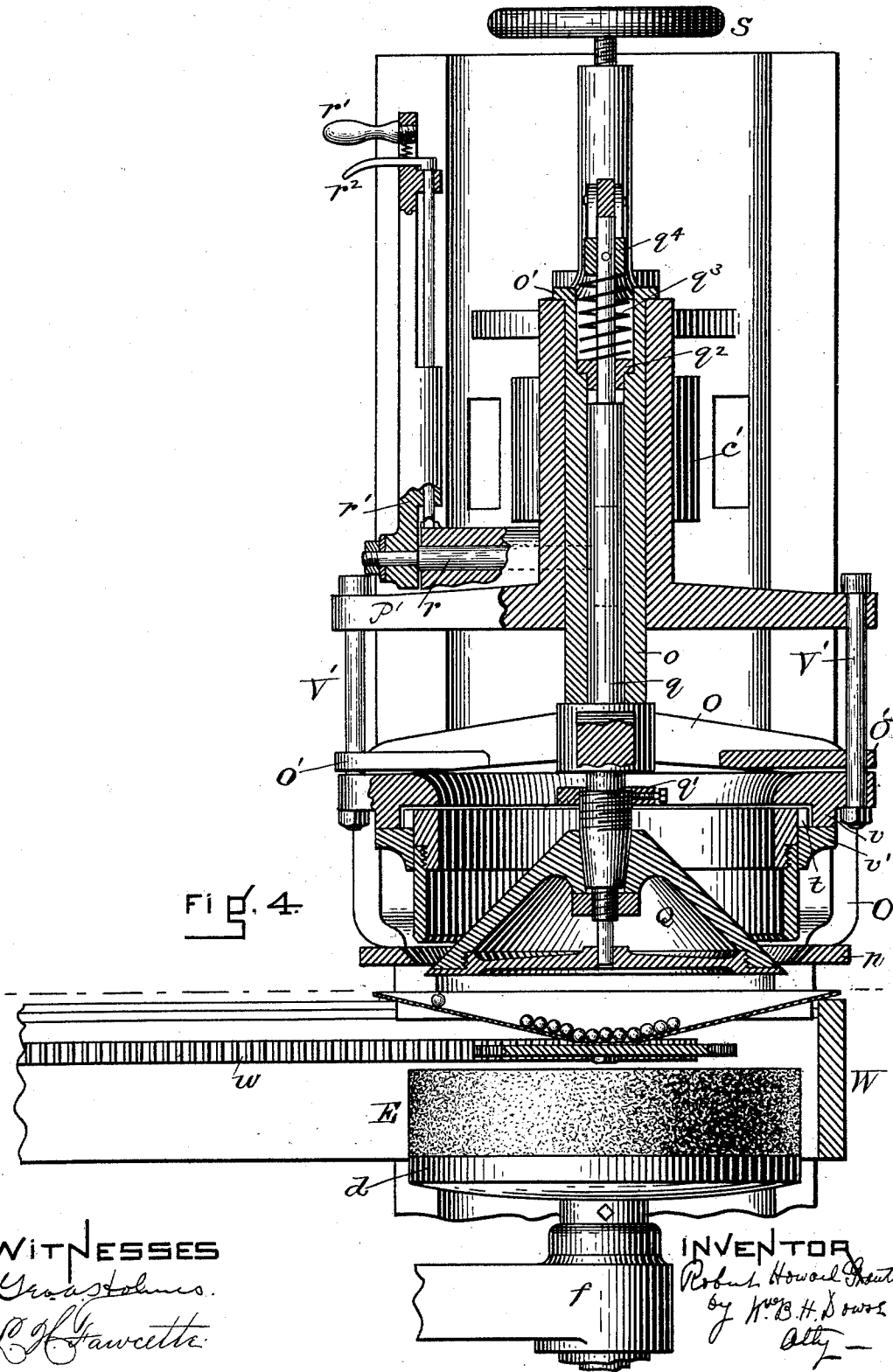
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4 Sheets—Sheet 3.

R. H. GRANT.  
GRINDING MACHINE.

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Patented May 15, 1894.



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(No Model.)

4 Sheets—Sheet 4.

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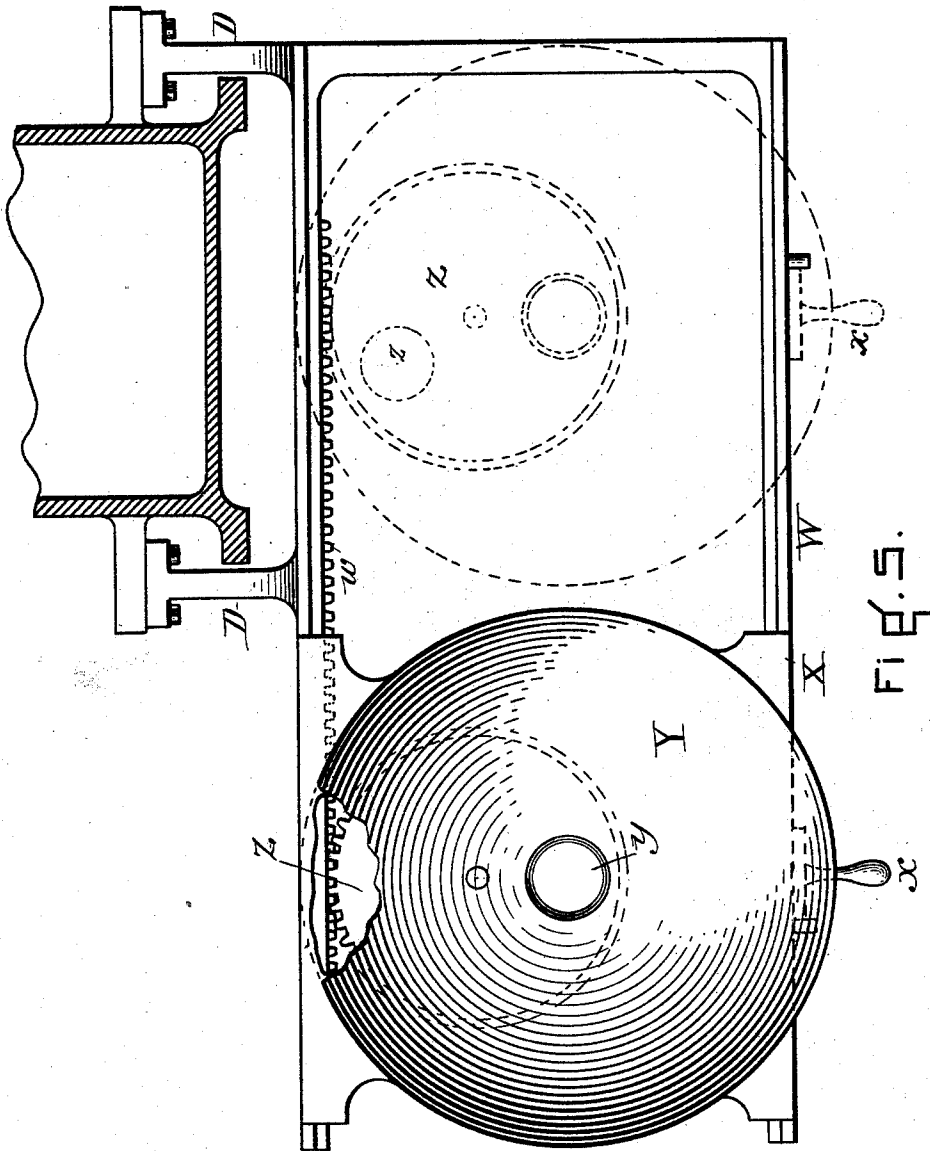


FIG. 5.

WITNESSES.

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# UNITED STATES PATENT OFFICE.

ROBERT HOWARD GRANT, OF FITCHBURG, MASSACHUSETTS, ASSIGNOR TO  
THE GRANT ANTI FRICTION BALL COMPANY, OF SAME PLACE.

## GRINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 520,019, dated May 15, 1894.

Application filed November 29, 1892. Serial No. 453,509. (No model.)

*To all whom it may concern:*

Be it known that I, ROBERT HOWARD GRANT, a citizen of the United States, residing in Fitchburg, in the county of Worcester and Commonwealth of Massachusetts, have invented certain new and useful Improvements in Grinding-Machines, of which the following is a full specification.

My invention relates to that class of machines designed to grind to a true sphere or nearly so, metallic balls which have previously been turned approximately spherical in a turning machine. In coming from the turning machine, the balls vary two and one-half one-thousandths from a true sphere, and my machine is designed to reduce this variation to a minimum by means of special features of construction which are hereinafter pointed out.

One of the special features of my machine is the rapidity of turning out work, which is due to an improved method of loading and unloading the machine, hereinafter described. Another is that the driving ring which revolves in a horizontal plane and drives the balls in the race over the emery wheel is stationary vertically and is thus held more accurately and firmly than is possible when it is capable of being raised and lowered.

Referring to the accompanying drawings wherein like letters represent like parts: Figure 1 shows a side elevation of my improved grinding machine. Fig. 2 shows a longitudinal section of same through axes of spindles, looking from side. Fig. 3 is a detail of indicating apparatus. Fig. 4 is a vertical section, through upper spindle, looking from the front. Fig. 5 shows a plan of mechanism used in unloading the machine and disposing of the balls when ground.

In Fig. 1, A is the casting forming the frame of the machine.

B and C are idle pulleys over which run the belts *b*, *c*, respectively turning the pulleys *b'*, *c'*, and by them the emery wheel and the driving ring.

D is a bracket bolted to the frame and supporting the ways upon which the unloading apparatus works.

The emery wheel E rests on, and is secured to, the flat disk *d*, which forms a hub on the

upper end of the spindle *e*, revolving in the bearings *ff*. The thrust of *e* at the lower bearing is supported by the spherical bearing *g'*, as shown in the drawings. The bearings *ff* form part of the bracket F which slides up and down on vertical ways secured to the frame of the machine. It will thus be seen that the emery wheel may be raised or lowered by moving the bracket F up and down on the vertical ways. This is accomplished by the screw G turning in the bearings H' and H<sup>2</sup>, said bearings being projections on the frame of the machine. The lower bearing forms a step for the screw, and a set screw working in a circular slot in the end of the screw as shown in Fig. 2, prevents its being withdrawn from the step. The screw passes through the lug I, secured to the sliding bracket F; thus as the screw revolves on its axis, the bracket F is moved up or down. The screw G has at its upper end, the bevel gear *g*, meshing with the gear *i* on the short shaft *j*, carrying at its outer end the hand wheel J (Fig. 3). By means of the train K driven by the shaft *j*, the pointer *k* is revolved over a suitably graduated dial plate *k'*, showing by its position on said dial, the exact height to which the emery wheel is raised. This is a very important point in a grinding machine, as it makes it possible to grind any number of balls to exactly the same size without calipering each lot until the desired size is reached. It will be seen that this is the only adjustment necessary as the driving ring T is stationary vertically, the distance between the surface of the emery wheel E and the edge of the driving ring, shown by the position of the pointer on the dial plate, being the diameter of the balls.

The spindle *e*, carrying the emery wheel E at its upper end and capable of being raised and lowered as heretofore described, is driven by means of the pulley *b'*. This pulley is secured to a quill *l* which revolves in two bearings L', L<sup>2</sup>, in the bracket L rigidly attached to the frame of the machine and projecting through a vertical slot in the sliding piece F between the upper and lower ends. The pulley *b'* revolves between these two bearings L', L<sup>2</sup>, and the spindle *e* slides up and down through the quill *l*, but is made to revolve

with it by means of the key M, secured to the spindle and sliding in the key-way *m* on the inside of the quill. The assembly of these parts is clearly shown by the section in Fig. 2.

5 The balls to be ground are held over the emery wheel in a circular race N of the form of an inverted truncated conical annulus, its axis being eccentric with the axis of the emery wheel. The outer wall of this race is  
10 formed by the ring *n* bolted to the arms of the spider O which is secured to the lower end of the sleeve *o* sliding in the sleeve P which forms part of the frame of the machine. The inner wall of the race N is formed  
15 by the cone Q. This is fixed to the lower end of the spindle *q* working in the sleeve *o*, and capable of being lowered by the lever Q', at its upper end, pivoted on the sleeve *o*. It will be seen by the drawings that although  
20 the spindle carrying the cone may be lowered as shown in Fig. 4, it cannot be raised in the sleeve *o* beyond the position shown in Fig. 2, on account of the collar *q'* fixed on the lower end of *q* and bearing against the under side  
25 of spider O. The collar *q'* is pressed up against spider O by means of the spring *q<sup>3</sup>* compressed between the bushing *q<sup>2</sup>* resting on the shoulder on the inside of the sleeve *o*, and the nut *q<sup>4</sup>* on the upper end of the spindle *q*. The compression of the spring *q<sup>3</sup>* may  
30 be varied by screwing the nut *q<sup>4</sup>* up or down on the spindle *q* which is of smaller diameter at the upper end as shown, to allow room for the bushing, spring, &c. The collar *q'* is adjusted on the spindle by means of a set screw  
35 so that in the highest position of the cone, its lower edge forming the race is in the same horizontal plane as the lower edge of the ring *n*. It will thus be seen that moving the sleeve  
40 *o* moves the whole race, without changing the relative position of the cone and ring; this relative position being altered only by pressing down the handle Q'. The whole sleeve  
45 *o* and consequently the race consisting of the cone and ring may be raised or lowered within the outer sleeve P by means of the rack *p* on the back of sleeve O, meshing with the pinion R on the short shaft *r* bearing in the frame of the machine. On the outer end of shaft *r*  
50 is the lever *r'* by which the pinion is revolved in order to raise or lower the race. This lever has the latching arrangement *r<sup>2</sup>* so that it can be secured in any position. The race is also constantly urged upward against the stationary driving ring T by means of the rack *s*  
55 gearing with the pinion R, diametrically opposite to rack *p*, and pressed down by the spring *s'*. The compression of this spring is varied by the plunger *s<sup>2</sup>* which is screwed up  
60 or down by turning the hand wheel S.

The driving ring T which has the form of a hollow cylinder, has at its upper end a flange or hoop having gear teeth *t* on its periphery. This meshes with the pinion U on  
65 the spindle *u*, which carries on its upper end the pulley C' driven as hereinbefore described by the belt C. The driving ring T is sup-

ported by the ring V which forms part of the frame of the machine. Ring V is also supported by the bolts V' V' passing through  
70 lugs on its periphery and hung from the yoke P' (Fig. 4) which forms part of the lower end of the sleeve P. These bolts pass through brackets O' on the spider arms and thus serve as guides for said spider as it slides up and  
75 down.

The inside diameter of the ring V is the same as that of the inside diameter of the driving ring, and its upper edge is rounded to form a hopper into which the balls are fed.  
80 The outer edge of ring V has a downwardly projecting flange *v* which surrounds the geared flange *t* on the driving ring; and secured to the lower edge of this flange *v* is the collar *v'* which embraces the driving ring just  
85 below the geared flange *t*, which bears upon it. Thus as the driving ring is driven it turns in, and is supported by, the collar *v*.

W is a frame secured to the frame of the machine by brackets D D having on its upper  
90 side horizontal ways upon which slides a carriage X supporting a pan Y into which the balls are unloaded from the machine. The carriage is moved back and forth on the ways by means of the handle *x*, and as it moves, it  
95 revolves the disk Z on whose edge are cut gear teeth which mesh with the rack *w* on the inside of one of the ways of frame W.

Disk Z is eccentric with the pan. The pan is conical with a hole in the bottom which is  
100 automatically opened or closed by the disk Z as follows: The disk has a hole *z* through it of the same size as hole *y*, and in such a position that as the pan is moved on the ways and the  
105 disk Z revolves over the hole *y*, the two holes *y* and *z* are superimposed only when the pan is in its position farthest away from the machine. In this position the balls which have been unloaded from the machine into the pan, drop into a box or any other receptacle  
110 beneath. When the pan is at the other end of the ways, in order to receive the balls from the machine the solid part of the disk is under the hole *y* which is consequently closed.

In order to unload the machine, the emery  
115 wheel is first lowered out of the way of the pan W, which is then slid up under the race. The whole path is then lowered away from the driving ring by the lever *r'* as hereinbefore described. The cone Q is then further  
120 lowered by pressing down the handle Q' and the balls drop out into the pan, which is then removed, depositing the balls. As soon as the balls are out of the race, the handle Q' is released and the spring *q<sup>3</sup>* brings the cone up  
125 again to the level of the ring *n*, more balls are fed into the race through the driving ring and the race is raised against the driving ring. These balls are then ground to the desired size, indicated by the index *h* on the  
130 dial plate, and the operation is repeated.

I claim—

1. In a grinding machine, a vertically stationary driving ring, a vertically movable

5 race, an emery wheel mounted on a vertically sliding bracket F, a screw G, a hand wheel J and dial  $k'$ , whereby the position of the emery wheel, relative to the driving ring is indicated substantially as described.

10 2. In a grinding machine, the race N consisting of the ring  $n$  and the cone Q in combination with the sleeve  $o$ , the rack  $p$ , the pinion R and the lever  $r'$  whereby the race N is lowered substantially as described.

15 3. In a grinding machine, the race N consisting of the ring  $n$  and the cone Q, and the sleeve  $o$  in combination with the spindle  $q$ , the spring  $q^2$ , and the handle Q' whereby the cone is lowered independently of the ring  $n$  substantially as described.

20 4. In a grinding machine, the driving ring T provided with the geared flange  $t$ , in combination with the collar  $v'$ , the rigid flanged supporting ring V, and the pinion U, the spindle  $u$  and the pulley  $c'$  whereby the driving ring is supported and driven substantially as described.

25 5. In a grinding machine, a vertically stationary driving ring in combination with a race N provided with a sleeve having a rack  $p$ , the pinion R, the vertical rack  $s$  the spring  $s'$  and the hand-wheel S whereby the pressure of the product of the machine against the driving ring is adjusted substantially as described.

6. In a grinding machine, a centrally perforated pan Y mounted on a rack frame W provided with a perforated geared disk Z whereby the pan holds or discharges the product of the machine when under or away from the machine substantially as described. 35

7. A grinding machine consisting of a vertically stationary driving ring T, a race N, a vertically movable emery wheel E, said driving ring being operated by the pinion U, the shaft  $u$ , and the pulley  $c'$ , and said emery wheel revolving in an opposite direction from that of the driving ring operated by the shaft and pulley, substantially as described. 40 45

8. A grinding machine consisting of the standard A provided with a vertically stationary driving ring T, a vertically movable race N, a vertically movable emery wheel E, a sliding shaft  $e$ , a sliding pulley  $b'$ , a sliding bracket F a screw G, a hand wheel J, a dial  $k'$ , a hand wheel S, the racks  $p$  and  $s$ , the pinion R, the spindle  $q$ , the sleeve  $o$  two levers  $r'$  and Q', a frame W, a pan Y, a disk Z, and connecting mechanism substantially as described. 50 55

In witness whereof I have hereunto set my hand.

ROBERT HOWARD GRANT.

Witnesses:

WM. B. H. DOWSE,  
E. H. GILMAN.