No. 611,968. Patented Oct. 4, 1898.

D. E. KEMPSTER.

AUTOMATIC BALL GRINDING MACHINE.

(Application filed Apr. 13, 1897.)

(No Model.)

Fig. 3.

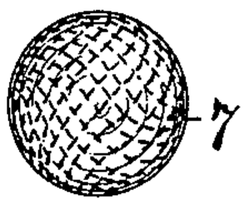


Fig. 1.

Fig. 4.

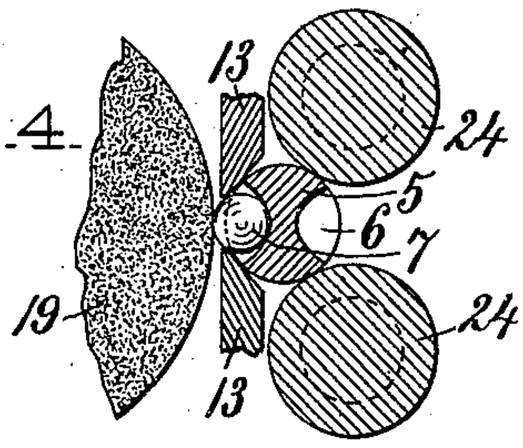


Fig. 5.

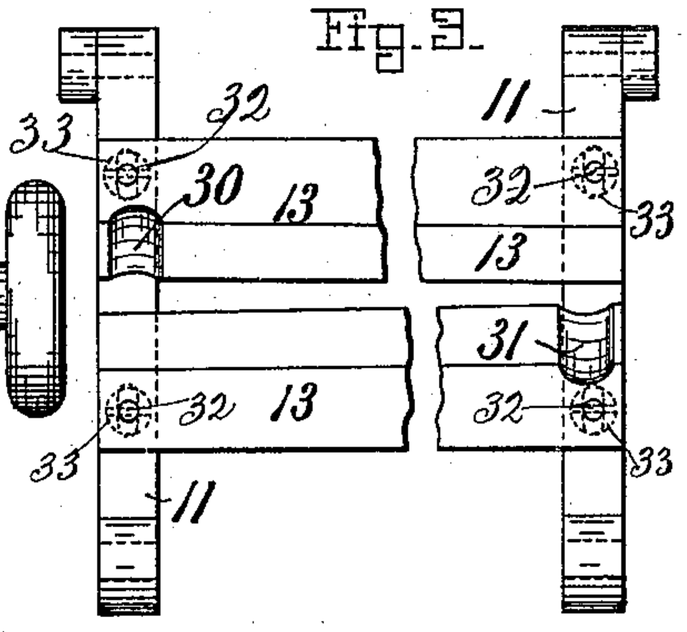
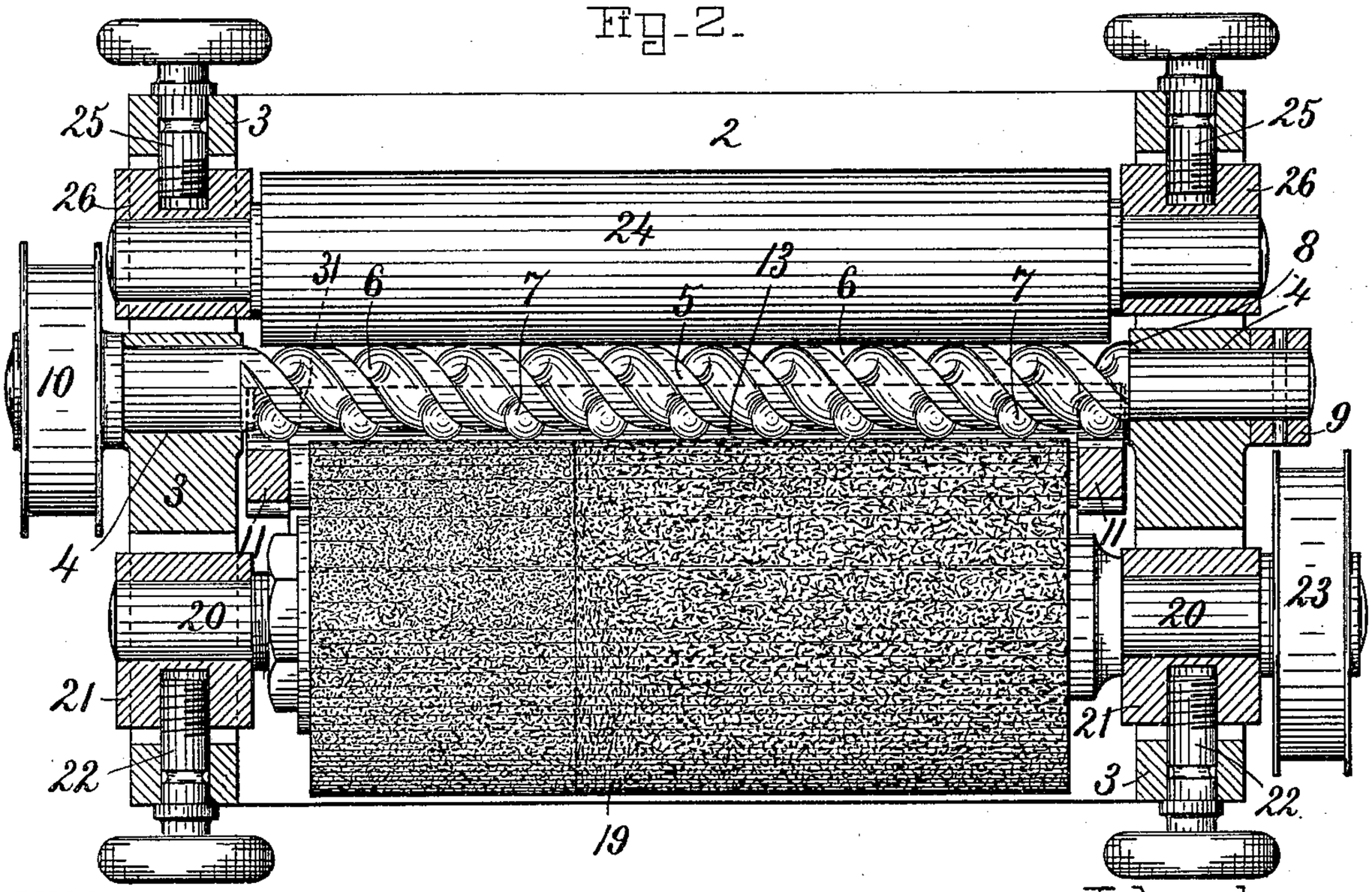


Fig. 2.



Witnesses.

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UNITED STATES PATENT OFFICE.

DANIEL E. KEMPSTER, OF BOSTON, MASSACHUSETTS.

AUTOMATIC BALL-GRINDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 611,968, dated October 4, 1898.

Application filed April 13, 1897. Serial No. 631,945. (No model.)

To all whom it may concern:

Be it known that I, DANIEL E. KEMPSTER, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Automatic Ball-Grinding Machines, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to improvements in machines for forming metal balls spherical; and the object and purpose of my invention are to provide an automatic, continuous, self feeding and grinding mechanism which will take rough balls of varying sizes from a receptacle or hopper and successively feed and grind them to size without hand manipulation or regrinding, as heretofore practiced prior to my invention.

My invention consists in the construction and combination of the various devices herein described, which constitute an organized ball-grinding mill or system whereby rough metal balls are ground to size in one grinding operation direct from a supply of loose balls within a suitable hopper or receptacle, all the elements or devices constituting said system acting and operating together to automatically, continuously, and expeditiously accomplish the desired end, as will now be fully described, and especially pointed out in the claims.

In the drawings, in which similar figures of reference indicate corresponding parts, Figure 1 represents a vertical section of my improved ball-grinding mechanism, the hopper and chute and its supporting-rest being shown in construction-lines. Fig. 2 is a horizontal section of the same. Fig. 3 is a detail view of the yielding ball-guide, the pressure-bars thereof being shown broken to reduce the size of drawing. Fig. 4 is a cross-section showing in detail one other form of backer or supporting device for the ball-conveying feed-roll. Fig. 5 is an enlarged elevation of a ball or sphere, the dotted lines thereon denoting the spirally-rolling movement given said balls or spheres in their passage along the feed-roll groove from end to end thereof, being caused to partake of a spirally-revolving movement by reason of the oblique or spiral groove, which tends by frictional contact on the balls or spheres under the rotation of the feed-roll to impart a spirally-rotating movement to said balls or spheres, more or less, according to the angle or pitch of said feed-groove.

My invention is susceptible of being constructed and arranged in various ways within the scope of mechanical skill and modified to suit the class of work being performed, always retaining, of course, the essential feature and spirit of my invention, and I wish to state in this connection that my present invention is somewhat in the nature of a modification of the invention secured to me by United States Patents Nos. 380,759 and 385,186 of 1888. In said patents I have shown, described, and claimed a die having an oblique working groove for rapidly conveying balls or spheres and imparting to them a spirally-rotating movement, whereby they may be acted upon on all parts and formed perfectly spherical, and I claim this improvement in the art to have been original with me, as set forth in the patents referred to.

For a certain class of work I find it convenient to construct and arrange the ball-grinding mill as shown in the accompanying drawings, in which a suitably-supported frame or bed 2, having upright ends 3, is provided with bearings 4, in which revolves on suitable journals the feed-roll 5, having oblique or spiral working grooves 6, said grooves being shaped in cross-section so as to admit a little more than one-half the diameter of the ball or sphere 7 to be conveyed therein, and while I have shown said grooves 6 to be rounded in cross-section I prefer for certain sizes of balls to form the feed-grooves V-shaped in cross-section, as they are held steadier while traveling along therein.

The grooved feed-roll is held from endwise motion by a shoulder 8 on one end thereof at one side of the bearing and a fast collar 9 on the opposite side of said bearing. A pulley 10 or other suitable driving device is fast on the opposite end of said grooved feed-roll 5 for giving said roll the required rotary motion.

A frame or two upright levers 11 are pivoted at their lower ends to adjustable ears 12 on the bed 2 and are located near the bearings for the feed-roll 5.

A guide for retaining the balls or spheres within and in frictional contact with the feed-groove, so as to be spirally revolved thereby

and compelling them to travel in a straight line across the machine, is composed of, preferably, two hardened-steel pressure-bars 13, fastened at their ends to the levers 11 and extending lengthwise the grooved feed-roll 5, the sides of said bars adjacent said feed-roll being preferably beveled or shaped so as to conform thereto and embrace the side of the roll, as shown in Figs. 1 and 4.

The pressure-bars 13 are arranged so as to form a tapering slot or opening between them and are separated far enough to admit a portion of the ball or sphere 7 to extend through beyond the face of the said pressure-bars. The bars 13 are fastened to the levers 11 by suitable screws 32, passing through slots 33 in said levers, so as to adjust the said bars 13 to and from each other, and thus change the width of the slot or space between them, as required for guiding the different-sized balls to be ground, as plainly shown in dotted lines in Figs. 1 and 3.

To the upper ends of the levers 11 are pivoted the eyebolts 14, which pass through ears 15 in the caps 16 of the bed. A spiral spring 17 is provided on each of said eyebolts between the ears 15 and suitable adjusting-nuts 18 on the ends of said bolts, thereby pressing said bars 13 toward the feed-roll 5 with an adjustable and yielding pressure.

It should be understood that in place of the springs 17 for holding the pressure-bars against the series of balls in frictional contact with the feed-groove I may use weights so arranged as to exert a similar yielding pressure thereon. Weights being a well-known equivalent in this connection I do not consider it necessary to illustrate them in the drawings.

A grinding-wheel 19, composed of emery or other suitable substance, extends nearly the length of the feed-roll and is secured to the shaft 20 in the usual manner by being clamped between flanges with a screw and nut on said shaft, as shown in Fig. 2. The journals of the grinding-wheel shaft are supported in boxes 21, resting in slots within the upright portions 3 of the bed and are held in place by the caps 16 thereon. The boxes 21 are provided with adjusting-screws 22, which pass through the part 3 of the bed, being held from endwise movement by a groove and pin in the usual manner, and are provided with suitable hand-wheels for turning said screws to move either end of the grinding-wheel to and from the pressure-bars 13, as required, a suitable pulley 23 being fast on the grinding-wheel shaft for giving it the necessary speed of revolution.

The grooved feed-roll 5 in order to admit of the use of pressure-bars for holding the balls or spheres within the grooves during the process of grinding is necessarily limited as to diameter, and if not backed up by a rigid support would spring as soon as the feed-groove filled with balls being ground by contact with the grinding-wheel, and to prevent any such springing and the consequent imperfect grinding which would result therefrom I provide a strong support behind the feed-roll, preferably one or more stout rolls 24, which revolve by frictional contact with the grooved feed-roll, being firmly held up against said feed-roll by suitable screws 25 and adjustable journal-boxes 26 similar to those just described with relation to the grinding-wheel.

A receptacle or hopper 27 is suitably supported above and at one side of the machine by the rest 28, so as to bring the chute 29 near the end of the feed-roll groove and central with said feed-roll. The chute 29 is constructed so as to contain a single row of balls one above the other and extends close to the feed-roll 5.

In the drawings both the feed-roll 5 and grinding-wheel 19 are designed to be revolved right-handed, and, assuming the hopper to contain rough balls or spheres, as shown, and the machine operated, the operation would be substantially as follows: When the feed-roll 5 revolves so as to bring one of its feed-grooves 6 directly under the chute 29, a ball 7 passes from said chute into the feed-groove and is carried around and downward into the position shown in Fig. 1, being caused to do so by reason of the hollowed-out or lateral groove 30 across the upper pressure-bar 13, forcing the ball downward into contact with the upper edge of the lower pressure-bar 13, where it is spirally revolved by the oblique or spiral feed-grooves and conveyed along across the machine, every part of its surface being acted upon by the grinding-wheel and equally ground, thus producing perfectly-spherical work. As the balls or spheres reach the end of their travel along the pressure-bars they are forced out of the feed-groove through the hollowed-out or lateral groove 31 in the lower pressure-bar 13 and drop into a suitable receptacle therefor.

The conveying-roll 5 may have one or more oblique or spiral feed-grooves, as desired. In the present drawings two of such grooves are shown, and consequently two balls will be successively forced into position to be spirally revolved and ground to size for every complete revolution of the grooved feed-roll, and so long as the hopper is kept supplied with rough balls the machine automatically and successively passes them through the feed-roll, spirally revolves them, and grinds them to size, and at ordinary speed a continuous stream of finished balls is being delivered.

I prefer to have the ball-guiding slot between the pressure-bars 13 slightly tapering, as shown in Fig. 3, being widest at the end where the balls first start to be ground and gradually reduced in width as the balls are ground smaller, as by so doing a more even pressure and frictional contact between the balls and feed-groove is obtained.

I have found it absolutely essential in practice to hold the feed-roll and ball-guide to-

ward each other with a yielding pressure, in order to prevent the rough balls from clogging in the groove of the feed-roll and becoming wedged between said groove and the ball-guide, and, furthermore, it is necessary to have the ball-guide apply a certain amount of yielding pressure to the balls within the feed-roll groove, in order to insure the balls being ground perfectly spherical and to exact size by being spirally revolved through frictional contact of the oblique feed-groove, while they are being conveyed along in a straight line across the ball-grinding surface.

It will be evident to a skilled mechanic that there are several ways of causing the feed-roll and ball-guide to clamp the balls between them with a yielding pressure, and I have illustrated herein one of such ways in which the pressure-bars 13 are held against the series of balls being ground with a yielding pressure to admit of rough and unequal balls passing through the feed-roll and being ground to size without clogging the machine, as would be the case if the pressure-bars and feed-roll were held rigidly in position.

I find it essential to back up the feed-roll with an adjustable bar or support, preferably the roll or rolls 24, arranged so as to be moved bodily to or from the said feed-roll, as by so doing I am able to take up all lost motion caused by wear of the parts and hold the grooved feed-roll exactly in line, so it cannot spring under the pressure put upon it, and thus insuring the balls or spheres being ground true and to proper size, and when considering the smaller sizes of feed-rolls for conveying the smaller sizes of balls it is absolutely necessary that said feed-roll be securely held or supported in the manner I have stated, in order to be able to grind said balls perfectly true to size and of true spherical shape.

I prefer to make the grinding-wheel 19 in two parts of two different grades of material, that part of the wheel which first acts upon the balls being of a coarse grade, say for about two-thirds its length, to grind the balls to size, and the balance of said wheel made of finer material to polish the balls. By so doing the balls can be more rapidly ground and a much finer and better finish given them than could be done otherwise, as with my invention they are ground and polished in one operation.

In Fig. 4 I have shown one other way of backing up the spirally-grooved feed-roll, and this would be preferable for the smaller sizes, as the supporting-rolls 24 are separated, so as to admit of the small feed-roll 5 being arranged partly between them, thus giving said feed-roll greater support and insuring the necessary rigidity without surrounding said feed-roll with a casing, which, as must be plainly evident, would be fatal to the practicable working of the machine.

It will be observed that I have constructed and arranged my machine so as to readily compensate for the natural wear of all the parts by making said parts adjustable, and I wish to again call attention to the fact that by making the ball-guide or pressure-bars self-adjusting with relation to the balls and feed-roll I am enabled to properly feed and grind balls that would otherwise clog and break the machine, owing to their roughness and variation in size.

It should of course be understood that many of the parts of my automatic ball-grinding machine may be changed within the scope of mechanical skill without evading the essential features and spirit of my invention.

Having used in my former patents before referred to a feed-roll having oblique or spiral working grooves for giving the balls a spirally-rotating movement and causing them to travel along in a line parallel with the axes of said feed-roll, I do not seek to claim it in this application; but the present construction and combination, with said feed-roll, of the ball-guide or yielding pressure-bars and a backer or supporting-rolls for the feed-roll, together with the multigrade or sectional grinding-wheel and mechanism for adjusting and operating the various devices whereby an organized automatic self-feeding ball-grinding mill, using rough balls direct from a suitable receptacle or hopper, is produced, I believe to be new in this class of machines.

Having now described the nature, construction, and operation of my invention, I desire to secure by Letters Patent and claim—

1. In an automatic ball-grinding mill, the combination of the following instrumentalities, viz. a frame or bed, a ball-feeding roll having an oblique or spiral groove, mechanism for revolving said feed-roll in suitable bearings, a hopper or chute adapted to hold a row of balls one above the other, a ball-guide extending lengthwise the feed-roll, having its inner edges thinned or beveled so as to overlap the balls and retain them within the groove of the feed-roll with a portion of their surfaces exposed for grinding, yielding mechanism between the feed-roll and ball-guide, a grinding-wheel, mechanism for revolving it, and mechanism for adjusting the position of the grinding-wheel with relation to the feed-roll, for the purpose set forth.

2. In an automatic ball-grinding mill, in combination, a frame or bed, a spirally-grooved feed-roll, mechanism for revolving said feed-roll in suitable bearings, a feed-roll backer or support, a hopper having a chute adapted to hold a row of balls one above the other, ball-retaining guide-bars, one above the other, extending lengthwise the feed-roll, yielding mechanism between the feed-roll and ball-guide, and a grinding-wheel having mechanism for revolving it, and mechanism for adjusting the distance between said wheel and ball-retaining guide and feed-roll, for the purpose set forth.

3. In a self-feeding ball-grinding machine, the combination of a suitable frame or bed, a

spirally-grooved feed-roll mounted in said frame or bed so as to be revolved, a ball-retaining guide extending along one side of said feed-roll, a backer or support on the opposite side of said feed-roll, mechanism for holding the feed-roll and ball-guide toward each other with a yielding pressure, and a grinding-wheel and mechanism for adjusting it to and from the feed-roll, for the purpose set forth.

4. In an automatic ball-grinding mill, the combination with a frame or bed having suitable bearings and a feed-roll having an oblique or spiral working groove, of a chute for conducting the balls to be ground into said feed-roll groove, a support for the back of said feed-roll to prevent it from springing, a ball-retaining guide composed of bars extending lengthwise the feed-roll and adjacent thereto, yielding mechanism for holding the feed-roll and ball-guide toward each other, and an emery or other grinding wheel arranged so as to be adjusted with relation to the balls revolving between the ball-guide and feed-roll groove, so as to cause either end of said wheel to grind the balls more or less as desired, for the purpose set forth.

5. In a ball-grinding machine, the combination with the spirally-grooved feed-roll, its supporting-backer and a yielding ball-retaining guide extending lengthwise said feed-roll, of a chute for conducting the balls under said ball-guide and into said roll-groove, for the purpose set forth.

6. In a ball-grinding machine, a spirally-grooved feed-roll, in combination with a ball-retaining guide, having yielding bars with thin straight edges for overlapping the balls, extending lengthwise of the feed-roll, a grinding-wheel, and mechanism for varying the distance between either or both ends of said feed-roll and grinding-wheel, for the purpose set forth.

7. In a ball-grinding machine, the combination with an oblique or spirally grooved feed-roll and a slotted ball-guide extending lengthwise the feed-roll, of mechanism for holding the feed-roll and ball-guide toward each other with a yielding pressure, for the purpose set forth.

8. In a ball-grinding machine, the combination with a spirally-grooved feed-roll adapted to be revolved in suitable bearings, and an adjustable backer therefor, of a yielding ball-guide extending lengthwise the feed-roll having an opening or slot adapted to permit the balls within the feed-groove to protrude through said guide far enough to be engaged by a grinding-wheel, and compelling said balls to travel in a straight line across the surface of said wheel, for the purpose set forth.

9. In a ball-grinding machine, in combination, a spirally-grooved ball-feeding roll, and mechanism for revolving it, a grinding wheel or roll extending lengthwise on one side of the feed-roll, mechanism for revolving it, and a support or backer on the opposite side of said feed-roll, for the purpose set forth.

10. In a ball-grinding machine, the combination of a spirally-grooved feed-roll, a back supporting-roll, and a grinding-wheel, the axes of all three elements being substantially parallel with each other and in the same plane, for the purpose set forth.

11. In a ball-grinding machine, the combination with a spirally-grooved feed-roll, of a grinding-wheel having its axes of rotation substantially parallel with the axes of rotation of the said spirally-grooved feed-roll, and in the same horizontal plane therewith, for the purpose set forth.

12. In a ball-grinding machine, a frame or bed provided with upright or outstanding ends having three sets of journal-bearings arranged side by side and in substantially the same plane, the intermediate set being stationary and the other two sets composed of sliding boxes made laterally adjustable in a straight line with relation to the intermediate set, and mechanism for retaining said boxes in the desired position, for the purpose set forth.

13. In a ball-grinding machine, a spirally-grooved feed-roll and mechanism for revolving it, in combination with a yielding ball-guide extending lengthwise said feed-roll, overlapping and retaining the balls within the feed-groove and causing them to travel along in a straight line lengthwise said feed-roll and within said spiral groove, for the purpose set forth.

14. In a ball-grinding machine, a spirally-grooved feed-roll, in combination with a slotted ball-guide extending lengthwise said feed-roll and movable ears or adjusting mechanism for making it bodily adjustable with relation to said feed-roll, whereby said ball-guide may be adjusted to coöperate with feed-rolls having different diameters as required for conveying different sizes of balls, for the purpose set forth.

15. In a ball-grinding machine, a spirally-grooved feed-roll, in combination with a hinged or pivoted ball-guide extending lengthwise said feed-roll, and mechanism for holding said ball-guide against or toward said feed-roll with a yielding pressure, for the purpose set forth.

16. In a ball-grinding machine, the combination with a spirally-grooved feed-roll, of a ball-retaining guide composed of two bars arranged edge to edge, and apart from each other, and extending lengthwise the said feed-roll, for the purpose set forth.

17. In a ball-grinding machine, the combination with a straight ball-retaining guide, a grinding-wheel, mechanism for revolving it, and mechanism for adjusting its position with relation to the ball-guide, of mechanism for spirally revolving the balls while they are being conveyed along the ball-guide, for the purpose set forth.

18. In a ball-grinding machine, the ball-guiding pressure-bars and frame or levers therefor pivoted to the frame or bed of the

machine, in combination with adjustable mechanism for holding said pressure-bars in position with a yielding pressure, for the purpose set forth.

19. In a ball-grinding machine, the spirally-grooved feed-roll, combined with a friction-applying ball-guide having thin or beveled edges having a laterally-adjustable slot, for the purpose set forth.

20. In a ball-grinding machine, the combination with a spirally-grooved feed-roll, of a feed-roll backer, preferably a rolling support, and mechanism for adjusting and keeping said backer or rolling support in frictional contact with said feed-roll, for the purpose set forth.

21. In a ball-grinding machine, a frame or bed, a frame or levers pivoted thereto, and pressure-bars extending across said frame or levers, combined with mechanism for holding said pressure-bars on said pivoted frame or levers so as to be capable of adjustment, whereby the ball-guiding slot between said pressure-bars may be changed or made wider or narrower as required, for the purpose set forth.

22. In a ball-grinding machine, the combination with a spirally-grooved feed-roll and a grinding-wheel arranged adjacent thereto, of pressure-bars extending lengthwise the feed-roll between said feed-roll and said grinding-wheel, and having their inner edges beveled or shaped so as to conform to the side of said feed-roll, for the purpose set forth.

23. In a ball-grinding machine, the combination, with a suitable frame or bed, a spirally-grooved feed-roll mounted therein so as to be revolved, a ball-retaining guide extending along one side of said feed-roll, mechanism for holding the ball-guide toward or against said feed-roll with a yielding pressure, a backer held against the opposite side of said feed-roll, and a grinding-wheel having mechanism for revolving it and mechanism for adjusting its position with relation to the feed-roll, for the purpose set forth.

24. In an automatic ball-grinding machine, the combination, with a frame or bed having suitable bearings, and a roll having an oblique or spiral working groove, of a receptacle or chute for conducting the balls into said roll-groove, a support for the back of said grooved roll to prevent it from springing, a ball-retaining guide composed of bars extending lengthwise the axes of said grooved roll, mechanism for permitting said bars to move laterally against a yielding pressure, and an emery or other grinding wheel having mechanism for adjusting its position so as to cause either end of the said wheel to grind the balls more or less as desired, for the purpose set forth.

25. In a ball-grinding machine, the combination with an oblique or spirally grooved roll, a ball-retaining guide extending in a straight line lengthwise the said roll, and mechanism for holding said ball-guide in position toward or against said roll with a yielding pressure, of a chute for conducting the balls into said roll-groove and under said ball-guide, for the purpose set forth.

26. In a ball-grinding machine, in combination, an oblique or spirally grooved roll, a ball-retaining guide extending lengthwise the said grooved roll, mechanism for holding said ball-guide toward said roll with a yielding pressure, and a grinding-wheel having mechanism for revolving it and mechanism for adjusting its position relative to the ball-guide or grooved roll as required, for the purpose set forth.

27. In a ball-grinding machine, an oblique or spirally grooved roll, in combination with a ball-retaining guide extending along the surface of the roll and held thereto by yielding mechanism, and having lateral grooves as described for receiving or delivering the balls, for the purpose set forth.

28. In a ball-grinding machine, the combination with an oblique or spirally grooved roll, and a grinding-wheel arranged adjacent thereto as described, of a yielding ball-guide extending between said grooved roll and grinding-wheel and having a hollowed-out lateral groove for admitting the balls between the grooved roll and ball-guide, for the purpose set forth.

29. In a ball-grinding machine, in combination, an oblique or spirally grooved roll, a grinding-wheel arranged adjacent thereto as described, a yielding slotted ball-guide extending along between the grooved roll and grinding-wheel and devices for presenting and delivering the balls to and from the grooved roll, for the purpose set forth.

30. In a ball-grinding machine, the combination with an oblique or spirally grooved roll, and a grinding-wheel arranged adjacent thereto as described, of a ball-guide composed of two bars extending along between the grooved roll and grinding-wheel, said bars being separated to form a ball-retaining slot, the upper bar being cut away or grooved laterally under the chute to receive the balls therefrom, and the lower bar being cut away or grooved laterally at the opposite end of said bars for permitting the balls to drop out after being ground, for the purpose set forth.

31. In a ball-grinding machine, the ball-retaining guide composed of two side pieces or levers, two bars arranged edge to edge and separated to form a ball-guiding slot between them, combined with adjustable mechanism for attaching said bars to said side pieces or levers, so said bars may be adjusted, to change the width of the ball-guiding slot, for the purpose set forth.

32. In a ball-grinding machine, a frame or side levers, combined with two ball-guiding bars extending across said frame or levers and constructed so as to receive and deliver the balls, substantially as and for the purpose set forth.

33. In a self-feeding ball-grinding machine,

the combination of the following instrumentalities, viz., a frame or bed having suitable bearings, an oblique or spirally grooved roll, mechanism for giving said roll the required movement, a chute for conducting the balls into said roll, a support or backer for said roll to prevent it from springing, a ball-guide extending along the face of the roll for retaining the balls within the roll-groove and causing them to travel in a straight line, mechanism for causing the ball-guide to be held in position with a yielding pressure so as to allow it to move laterally, a grinding-wheel adjacent to said roll, mechanism for adjusting the position of said grinding-wheel with relation to said roll, and mechanism for revolving said grinding-wheel, for the purpose set forth.

34. In a ball-grinding machine, a frame or bed, an oblique or spirally grooved roll, and a yielding ball-guide extending lengthwise of said roll, in combination with a multigrade abrading-wheel adapted for grinding and polishing the balls in one and the same operation, substantially as herein described.

35. In a ball-grinding machine, the combination with a spirally-grooved feed-roll mounted in suitable bearings so as to be revolved, a feed-roll backer and a ball-retaining guide extending lengthwise of said feed-roll, of a sectional abrading-wheel adapted to both grind and polish the balls at one and the same operation, substantially as set forth.

36. In a ball-grinding machine, mechanism for spirally revolving and conveying the balls in a straight line, substantially as described, comprising a roll having a plurality of oblique or spiral grooves and a guide extending along said roll, combined with mechanism for holding said roll and guide together with a yielding pressure, for the purpose set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 8th day of April, A. D. 1897.

DANIEL E. KEMPSTER.

Witnesses:
FRED JOY,
HENRY CHADBOURN.