A. F. ROCKWELL.

GRINDING MACHINE.

APPLICATION FILED OCT. 6, 1910.

1,176,099. Patented Mar. 21, 1916.

Fig 4

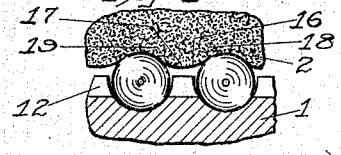

Fig 5

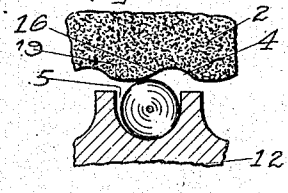

Fig 1

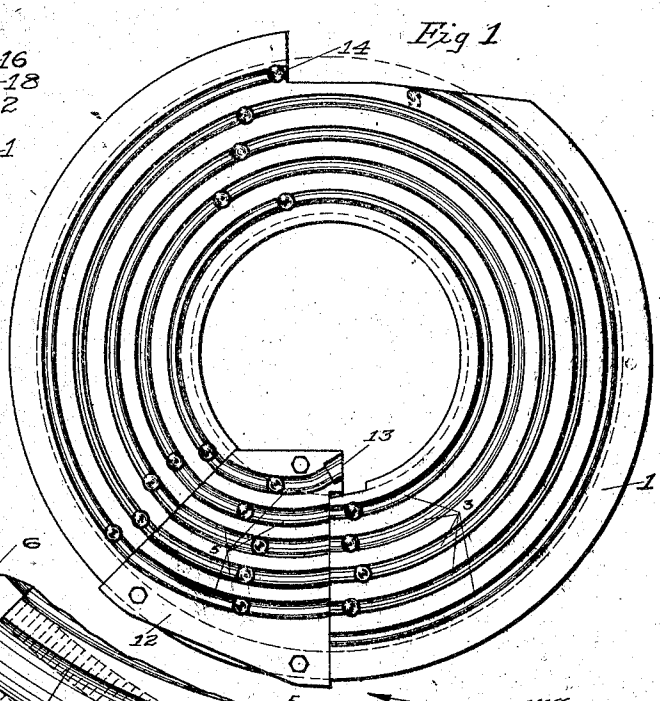

Fig 2

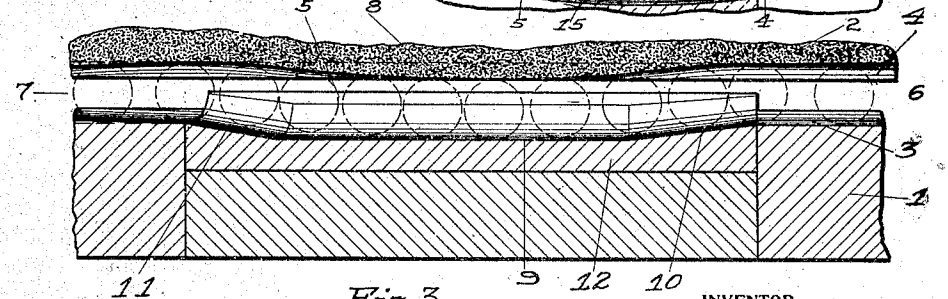

Fig 3

WITNESSES

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GRINDING-MACHINE.

1,176,099. Specification of Letters Patent. Patented Mar. 21, 1916.

Application filed October 6, 1910. Serial No. 585,592.

To all whom it may concern:

Be it known that I, ALBERT F. ROCKWELL, a citizen of the United States, residing at Bristol, county of Hartford, State of Connecticut, have invented a certain new and useful Grinding-Machine, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to grinding machines, and is particularly applicable to those machines for grinding balls in which the balls traverse a series of grinding grooves which are connected by transfer grooves.

Heretofore it has been customary to provide ball grinding machines with a suitably supported stationary guide disk and a cooperative, rotative abrasive disk, said disks having a concentric series of matching grooves in which the balls are received and ground, the said guide disk also having transfer grooves, each of which extends across the line of a rib of the abrasive disk and connects one grinding groove with the next, whereby each ball takes an orderly course through all of the said concentric grinding grooves and traverses the same path traversed by each other ball, thus securing uniformity of product. In such machines it has been customary to provide the said guide disk (or its transfer plate) with fingers or like deflectors which obstruct the said grinding grooves and carry the balls into the transfer grooves, whereby during either the whole or some considerable portion of the length of each transfer groove a ball is wholly out of control of and out of contact with the said abrasive disk.

My object is to reduce the cost of such machines, provide for smoother and more even travel of the balls through the machine, provide for increased grinding action, and secure continuity of the grinding action.

To these ends, and also to improve generally upon devices of the character indicated, my invention consists in the various matters hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a face view of the guide disk of such a machine, the position of the edges of the coöperating abrasive disk being indicated by broken lines; Fig. 2 is an enlarged detail of a portion of the said guide disk and its transfer plate, the positions of the ribs of the coöperating abrasive disk being indicated by broken lines; Fig. 3 is a fragmentary sectional elevation through the guide disk and abrasive disk on about the line 3—3 of Fig. 2; and Figs. 4 and 5 are fragmentary elevations of such disks on about the lines 4—4 and 5—5, respectively, of Fig. 2.

In the illustrated embodiment of my invention, 1 indicates the guide disk and 2 the abrasive disk, said guide disk having the concentric grooves 3 and the abrasive disk having the coöperating and matching concentric grooves 4 for receiving and grinding the balls. Said guide disk also has the transfer grooves 5 which connect what may be termed the delivery end of one said concentric groove, such as 6 (Fig. 2), with what may be termed the receiving end of the next, such as 7, a transfer groove thus extending across the line of a rib, such as 8, of the abrasive disk and having its middle portion 9 deeper than its entrance and exit points to permit balls to pass under such rib 8, the middle portion 9 being connected to such entrance and exit points by the inclined portions 10 and 11. The transfer grooves are usually formed in a detachable transfer plate 12. The entrance opening 13 and the exit opening 14 permit the admission and discharge of balls.

According to my invention the depth of the transfer groove is such that throughout its length the distance from its bottom to the opposing portion of the face of the abrasive disk is approximately that of the diameter of the ball being acted upon, as shown particularly in Figs. 3, 4 and 5. Thus, even while traversing a transfer groove, the ball is confined between the coöperating disks 1 and 2 and by these elements themselves, the necessity for deflecting fingers and the like being thereby avoided. Furthermore, the distance between the line of said transfer groove upon which the ball tracks and the said opposing portion of the face of the abrasive disk is preferably such that the ball is in grinding contact with the said abrasive disk even while traversing the transfer groove, whereby not only do the two disks themselves serve to confine the ball but the ball is ground during the whole of the trans-

fer operation, thus securing for each ball continuous grinding during the whole of its passage through the machine and avoiding interruptions of such grinding.

As is well understood, the balls receive motion from their contact with the rotating abrasive disk, and this rapidly rotating disk causes the balls, upon leaving a concentric groove, to impinge against the inclined wall, such as 15, of the transfer disk, whereupon the balls are forced by such inclined wall to change their direction of motion and to travel in a line oblique to their original line of motion and intersecting the line of the neighboring rib 8 of the abrasive disk. Therefore, said wall of the transfer disk tends to crowd a ball against the relatively fragile rib 8 of the abrasive disk. In order to avoid possibility of thus breaking such rib with injurious effect, I prefer to gradually incline such rib in cross section, as shown at 16, Figs. 4 and 5, from its bottom point 17 to the outer point 18 of that portion of the groove, which engages the ball when the latter is in the matching concentric grooves of the two disks, and I also prefer to strike the transfer groove 5 upon a somewhat greater radius than that of the ball, as also shown in Figs. 4 and 5. Thus, when a ball enters a transfer groove, not only can it drop along the incline 10 away from the bottom of the groove of the abrasive disk, but the abrasive rib is itself cut back, as at 16 in Fig. 4, and the ball can also move slightly sidewise in the groove 5, as shown in Fig. 5, whereby breaking strain against the rib 8 is avoided and the ball travels satisfactorily under the rib. After passing under the rib, the ball travels up the incline 11 to leave the transfer disk and enter the new concentric groove, the corner 19 of the abrasive rib 8 being also preferably inclined, as shown in Fig. 4, to prevent breaking of such rib as the ball rises into its new groove.

I have found that most satisfactory grinding results are obtained when the concentric grooves 3 and 4 are of a depth equal to about one quarter of the diameter of the ball being acted upon. But in order to avoid any possibility of a ball (particularly when of small diameter) being shoved over the rib of the transfer groove during the transfer of the ball, I prefer to make such transfer groove considerably deeper even at its entrance and exit points, a satisfactory depth at such points being about one-thirty-second of an inch greater than one half of the diameter of the ball and the edge of the rib defining a straight line between said two points, as shown in Fig. 3.

Of course, the abrasive disk 2 can be grooved and its ribs can be shaped as above described before such disk is mounted in the machine. But I have found that the abrasive-disk ribs can be most satisfactorily produced and shaped and the abrasive-disk grooves concurrently formed by assembling an abrasive disk with a plane surface in a machine with the guide disk 2 and permitting said disks to operate upon balls as if the abrasive disk had been fully grooved and shaped. In this way the balls themselves not only wear the grooves into the abrasive disk but they also shape its ribs, the open transfer groove (unobstructed by fingers or other deflectors) permitting the balls to themselves gradually produce the exact curve of the ribs necessary to permit proper passage of the balls across a rib. Thus, the open and unobstructed transfer groove of the present machine avoids the expense of deflecting fingers, avoids the impact of the balls against such fingers, and permits the grooves and ridges of the abrasive disk to be most perfectly and inexpensively produced. By locating the bottom or ball-tracking line of the transfer groove throughout its length a distance from the opposing face of the abrasive disk approximately equal to the diameter of the ball (and by such expression I mean such a distance that, although the balls may not actually engage the abrasive disk while traversing a transfer groove, still the distance is too little greater than the diameter of a ball to permit the balls to pile upon each other) the two disks themselves confine the balls and cause them to pass easily and evenly through the transfer grooves, piling and jamming of the balls being thereby avoided; and by making such distance such that the balls remain in grinding contact with the abrasive disk, the grinding action upon the ball is smooth and continuous during the entire passage of the ball through the machine and the machine is caused to give a ball the maximum amount of grinding. Furthermore, by inclining the edges of the ribs of the abrasive disk, breaking of such ribs is avoided, this feature being augmented by the above described proportionate width of the transfer groove.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is—

1. The combination with a grooved abrasive disk provided with a rib, of a coöperating guide disk having a transfer groove extending across the line of said rib, said transfer groove being open throughout its length and at its portion facing said rib, and means for preventing the articles acted upon from breaking said rib; substantially as described.

2. In a device for grinding articles, the combination with a grooved abrasive disk provided with a rib, of a coöperating guide disk having an open transfer groove extending across the line of said rib, said rib hav-

ing its edge cut-away to incline the side of said rib away from the normal track of the articles; substantially as described.

3. The combination with a grooved abrasive disk provided with a rib, of a coöperating guide disk having a transfer groove extending across the line of said rib, said transfer groove being open throughout its length and being of a width greater than that of the articles acted upon; substantially as described.

4. The combination with a grooved abrasive disk provided with a rib, of a coöperating guide disk having a transfer groove extending across the line of said rib, said rib having its edge cut-away, and said transfer groove being wider than the article acted upon; substantially as described.

5. The combination with a grooved abrasive disk provided with a rib, of a coöperating guide disk having a transfer groove extending across the line of said rib, said transfer groove being open throughout its length at its portion facing said abrasive disk and having its bottom throughout its length spaced from the opposing face of said abrasive disk a distance approximately that of the diameter of the articles acted upon; substantially as described.

6. The combination with a grooved abrasive disk provided with a rib, of a coöperating guide disk having a transfer groove extending across the line of said rib, said transfer groove being open throughout its length at its portion facing said abrasive disk and having its bottom throughout its length spaced from the opposing face of said abrasive disk a distance substantially that of the diameter of the articles acted upon, whereby said articles may be in grinding contact with said abrasive disk throughout their transit through said transfer groove; substantially as described.

7. In a device for grinding articles, the combination with a grooved abrasive disk provided with a rib, of a coöperating guide disk having a transfer groove extending across the line of said rib, said rib having its edge cut away to incline the side of said rib away from the normal track of the article; substantially as described.

8. A grooved grinding disk with its groove including a transfer-portion, such groove being open throughout its length and having portions of a width substantially equal to the diameter of the article acted upon, the transfer-portion of said groove having a substantially greater width crosswise of said groove than said first-named portions; substantially as described.

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

ALBERT F. ROCKWELL.

Witnesses:

CHARLES S. JOY,

HARRY W. TUTTLE.