C. A. HIRTH.

BALL GRINDING MACHINE.

APPLICATION FILED JAN. 16, 1909.

939,502. **Patented Nov. 9, 1909.**

Fig. 5

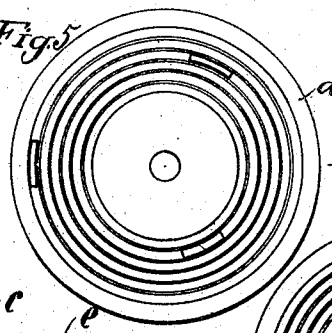


Fig. 1.

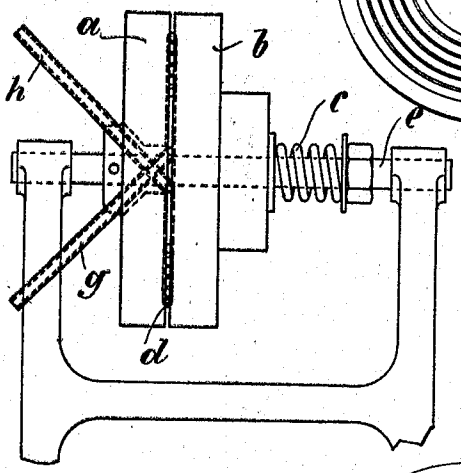


Fig. 2.

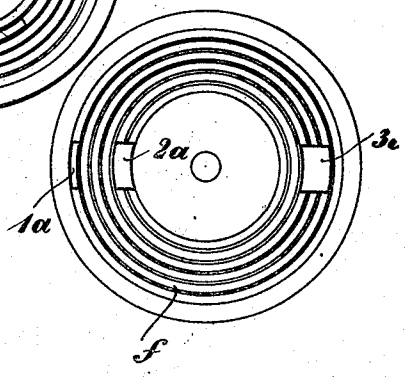


Fig. 6

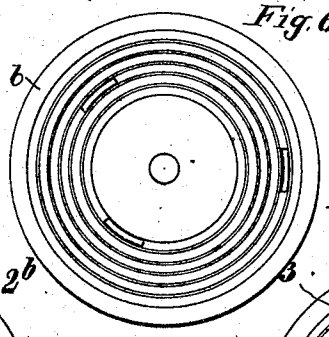


Fig. 3.

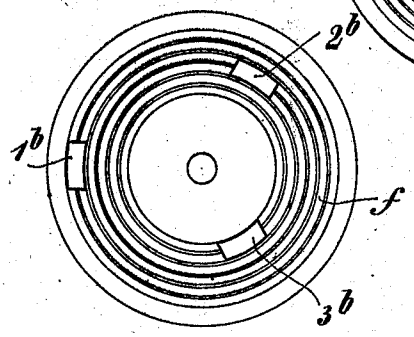
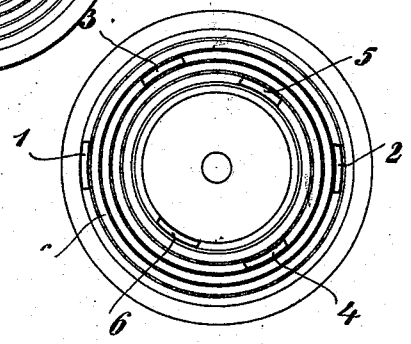


Fig. 4.



WITNESSES

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BALL-GRINDING MACHINE.

939,502. Specification of Letters Patent. Patented Nov. 9, 1909.

Application filed January 16, 1909. Serial No. 472,716.

To all whom it may concern:

Be it known that I, CARL ALBERT HIRTH, a subject of the Emperor of Germany, citizen of Cannstatt-Stuttgart, Germany, residing at Cannstatt-Stuttgart, Germany, have invented new and useful Improvements in or Relating to Ball-Grinding Machines, of which the following is a specification.

This invention relates to ball grinding machines and has reference to machines for grinding steel balls such as are to be used for ball bearings.

The invention is particularly applicable to machines of the type having a pair of grinding disks one or each of which is provided with annular grinding grooves in which grooves the balls are automatically ground to true spherical form and uniform diameter when the disks are turning against each other. Ball grinding machines of this type have been formed consisting of disks having annular grooves, the disks operating together in pairs, one of them being stationary and having in one place an interruption of all the annular grooves in order to enable the balls to leave their particular groove and to enter another, in which manner a greater degree of uniformity is imparted to the balls than would be if the balls remained always in the same annular groove.

Owing to the fact that the pair of ball grinding disks are pressed against each other by spring or weight pressure, the one-sided interruption or opening in the one disk causes a one-sided pressure on the counter disk since the balls are located between the two disks on that side of the center opposite to the interruption or opening while on the interrupted side the balls pass from between the disks through said opening and consequently allow the disks to spring or be pressed nearer together on the interrupted side. The balls are therefore submitted to unequal pressure during grinding and it is therefore necessary to make the disks and shafts very strong, which however, does not prevent unequal wear of the stationary disk taking place and as a consequence more frequent adjustment of the parts is rendered necessary.

The object of the present invention is to avoid these disadvantages, and this is accomplished by providing, instead of a single interrupting gap in all the annular grinding grooves, a plurality of gaps distributed over the working surface. The plurality of gaps are so located around the working surfaces of one or each disk that an equalization of pressure is maintained between the pair of disks, and as a result, an approximately complete uniformity in the effect of the pressure upon the balls is obtained. In other words, the interrupting gaps of the grinding grooves are symmetrically distributed over the working surfaces so that the loss of pressure caused by a gap in the one disk against the other disk is equalized by a corresponding reduction of pressure on the opposite side of the center. The gaps are symmetrically disposed on opposite sides of the center so that when the balls leave the grooves and pass into a gap on one side of the center, a corresponding gap on the opposite side of the center receives balls from the grooves so that the pressure on opposite sides of the center remains uniform. It will be seen therefore that the portions of the disk where the balls are being ground in the grooves, and also where they are removed from the grooves, being equalized or symmetrically disposed about the center of the disk a uniformity of pressure is applied to the balls around the whole surface of the disks.

In order that the invention may be clearly understood reference will be made in the following further description to the accompanying drawing, wherein:—

Figure 1 shows in side elevation a pair of grinding disks mounted on their spindle. Figs. 2, 3 and 4, are front elevations or face views of one of the disks and illustrate as examples different arrangements of the interrupting gaps in the disk according to this invention. Figs. 5 and 6 show the front or face views of two disks adapted to act together, both being provided with gaps.

A ball grinding machine, of the preferred construction, comprises mainly a stationary disk *a* and a rotatory disk *b* mounted upon the shaft *e* the rotatory disk *b* being pressed against the stationary disk *a* by means of a spring *c*. The disk *a* is made of metal

and is provided with concentric annular grooves *f* which serve to guide the balls *d* being ground and rolling between the two disks. The disk *b* may be made of metal or of a suitable grinding material such as emery.

The stationary disk *a* has hitherto been furnished with an interrupting gap on one side of the center *i. e.* on one side of the shaft *e* on which the disk *b* rotates, said gap embracing all the annular grooves *f* and allowing the balls to leave the annular grooves at the commencement of the gap in order to enter, at the end of said gap, different grooves. The present invention however, provides several gaps for the purpose of transferring the balls from one annular grinding groove *f* to another. It has been assumed in the Fig. 1 that these gaps are all provided in the stationary disk, the channels *g* taking the balls from the machine and the channels *h* taking them back again.

This invention is not concerned with the means which may be employed to both guide the balls from one gap to another outside the machine and mix the balls between their being removed from and again introduced into the machine. For these purposes any desirable means may be employed and the present invention comprehends only the provision and particular location of the plurality of gaps whereby the pressure upon the balls between the two disks is uniform all over or around the working surfaces.

In the examples illustrated in the accompanying drawing, for the sake of clearness it is assumed that only six annular grooves *f* are provided, although generally there is a considerably greater number.

In the arrangement illustrated in Fig. 2, three disk gaps 1^a, 2^a, 3^a are provided. The gaps 1^a and 2^a break the outermost and the two innermost annular grooves *f*, whereas the symmetrically opposite gap 3^a breaks the three intermediate annular grooves. In this way the loss of pressure on opposite sides of the center owing to the balls leaving the grooves *f* and entering the gaps is equal, the balls leaving a uniform number of grooves on opposite sides of the center.

In Fig. 3 the disk gap 1^b breaks the two outer annular grooves *f*, the gap 2^b the two middle grooves, and the gap 3^b the two inner grooves. The said gaps are disposed at 120° relatively to each other through the center so that the pressure is approximately equally distributed over the disk.

In Fig. 4 each of the annular grooves *f* is broken separately. The gaps 1 and 2, placed on opposite sides of the center, break the two outside annular grooves, the gaps 3 and 4 break the two middle grooves, and the gaps 5 and 6 the two inner grooves. In this example, for every two opposite gaps viz. 1 and 2, 3 and 4, 5 and 6 the loss of pressure is equalized with great approximation.

Although in the arrangements of the gaps illustrated in Figs. 2, 3 and 4 the equalization of the pressure is not perfect on account of the unequal distance of the gaps from the center of the disk, nevertheless a perfectly equal pressure could be obtained by more accurately disposing the gaps, say at slightly different angles relatively to each other or by making the gaps of different lengths.

In the example shown in Fig. 4 where each annular groove *f* is broken separately by the gaps 1 to 6, the balls arriving at said gap in each groove can be collected separately and be mixed systematically in any desired sequence in order to re-introduce them into different grooves as desired. By this means the uniformity of the balls ground in one charge is greatly increased.

It is immaterial in the type of machine to which the present invention is applied, whether the shaft *e* of the disks *a* and *b* is arranged horizontally, vertically or at any desired angle.

Although the gaps in the hereinbefore described construction are illustrated and described as being provided in one disk only, viz. the stationary disk *a*, yet such gaps may, if desirable be formed in both of the disks, as shown in Figs. 5 and 6 which illustrate the faces of two disks adapted to work together. The stationary disk *a* is provided in this case with three gaps which break the outermost, the third and fifth grooves. The rotating disk *b* has also three gaps which break the second groove from the outside, and the fourth and sixth grooves. In both disks the interrupting gaps are arranged symmetrically, thus compensating or equalizing the pressure.

What I claim then is:—

1. A ball grinding machine having in combination with a pair of grinding disks, one of said disks having a series of annular grooves and a plurality of gaps which interrupt said grooves to transmit the balls from one groove to another said gaps being arranged symmetrically around the center to equalize the pressure between the disks, substantially as described.

2. A ball grinding machine having in combination with a pair of grinding disks each furnished with a series of annular grooves on their meeting faces, one of said disks having a plurality of gaps which interrupt said grooves to transmit the balls from one groove to another said gaps being arranged sym-

metrically around the center to equalize the pressure between the disks, substantially as described.

3. A ball grinding machine having in combination with a pair of grinding disks each furnished with a series of annular grooves on their meeting faces, each of said disks having a plurality of openings which interrupt said grooves to transmit the balls from one groove to another said gaps being arranged symmetrically around the center to equalize the pressure between the disks, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CARL ALBERT HIRTH.

Witnesses:

IWAN RIESZ,

PAUL WILHELM FUNCK.