J. B. KRONABLE.

GRINDING MACHINE.

APPLICATION FILED SEPT. 3, 1920.

1,419,740. **Patented June 13, 1922.**

4 SHEETS—SHEET 1.

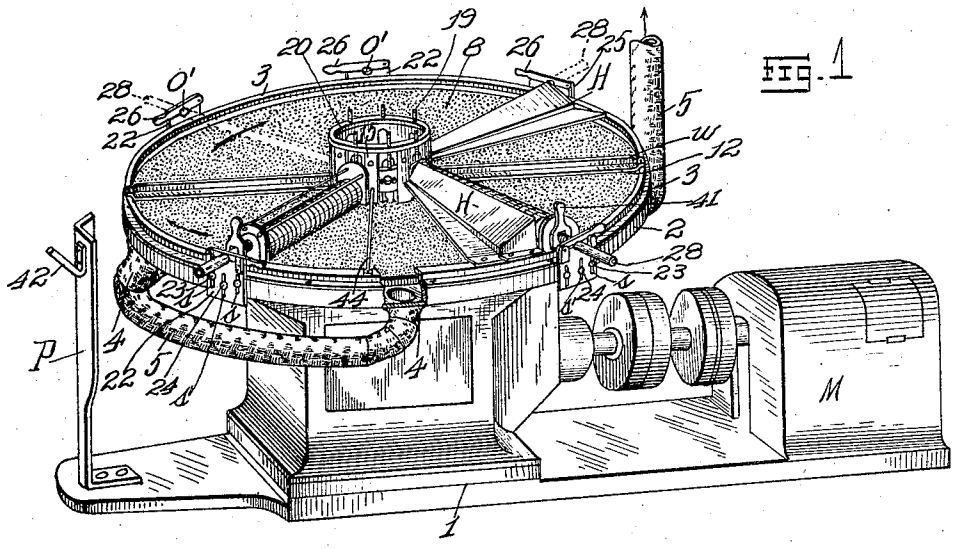


Fig. 1

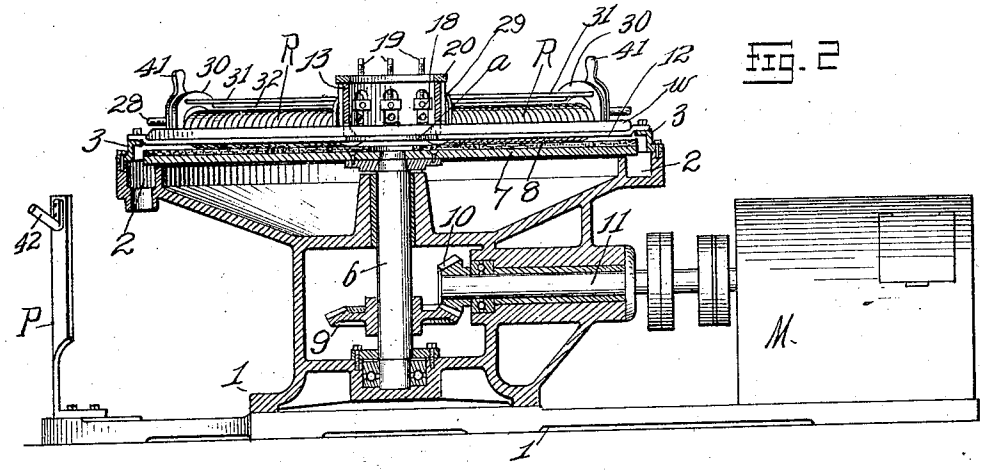
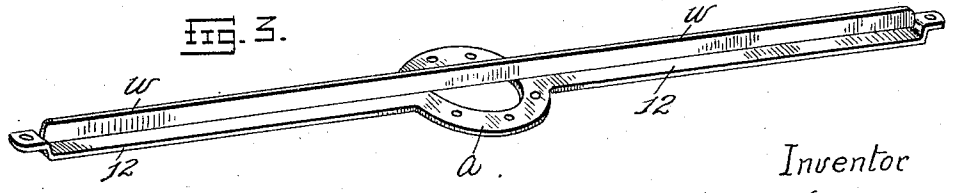


Fig. 2

Fig. 3.



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4 SHEETS—SHEET 2.

Fig. 4

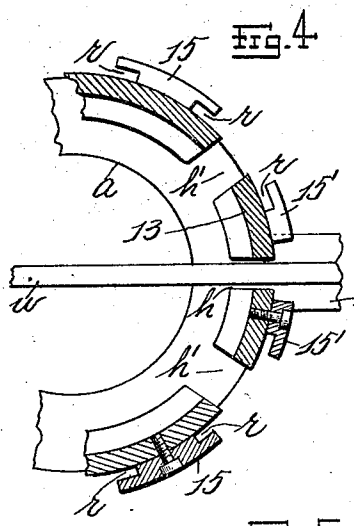


Fig. 5.

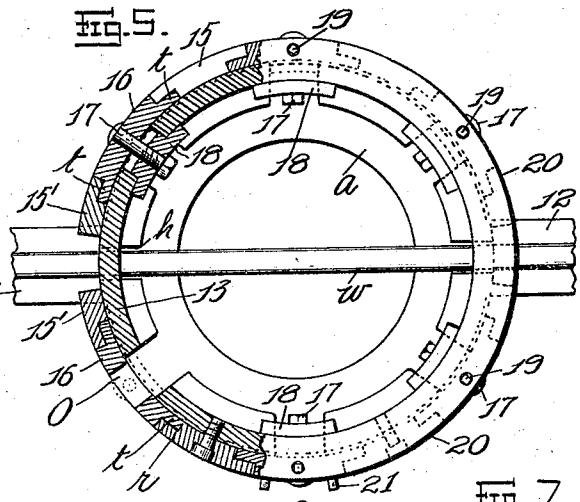


Fig. 6

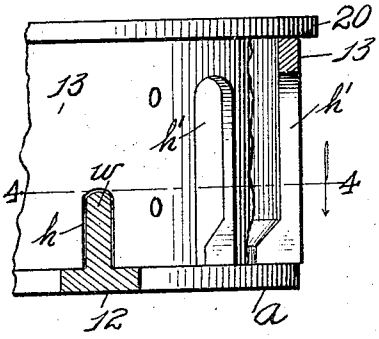


Fig. 7

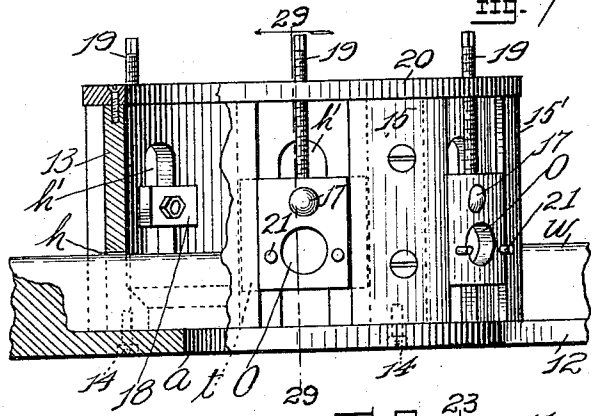


Fig. 8.

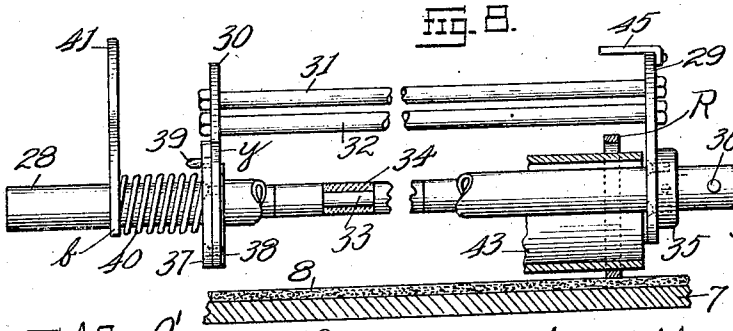


Fig. 9

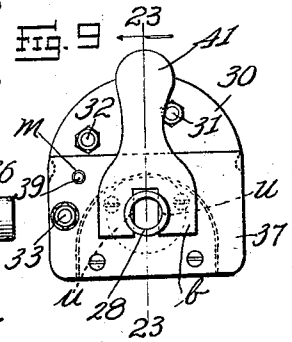


Fig. 10

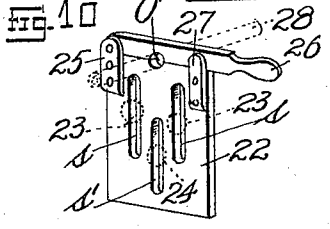
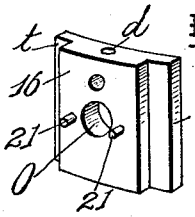


Fig. 11



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4 SHEETS—SHEET 3.

Fig. 12.

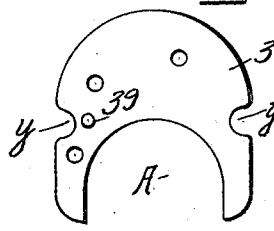


Fig. 13.

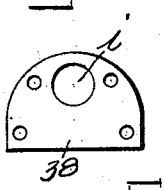


Fig. 14.

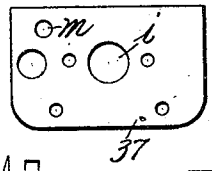


Fig. 15.

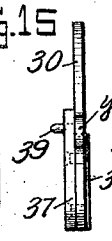


Fig. 16.

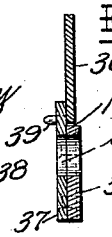


Fig. 17.

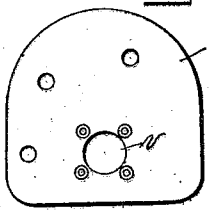


Fig. 18.

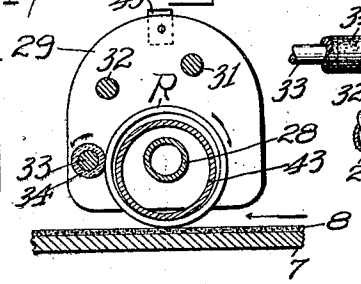


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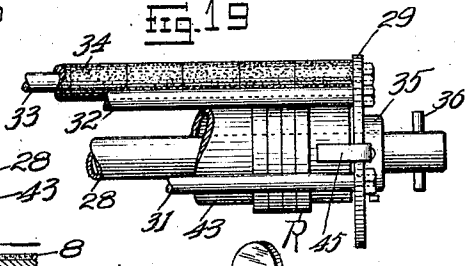


Fig. 20.

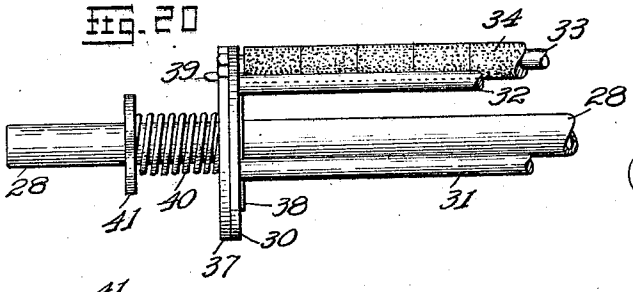


Fig. 21.

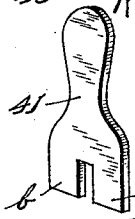


Fig. 22.

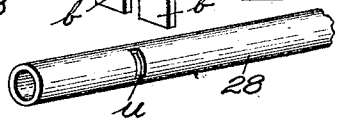


Fig. 23.

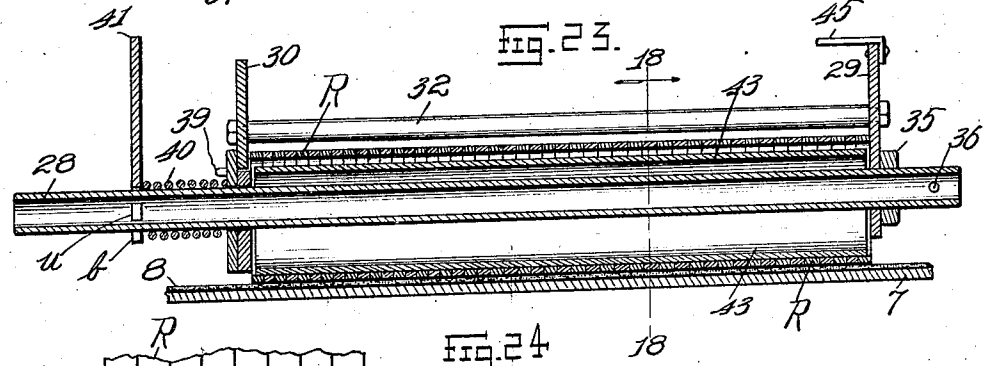
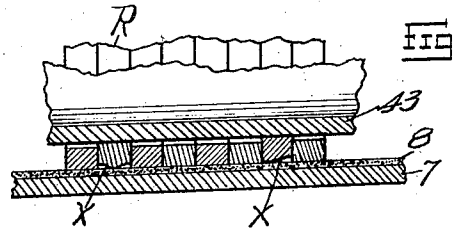


Fig. 24.



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GRINDING MACHINE.

APPLICATION FILED SEPT. 3, 1920.

1,419,740. Patented June 13, 1922.

4 SHEETS—SHEET 4.

Fig. 25.

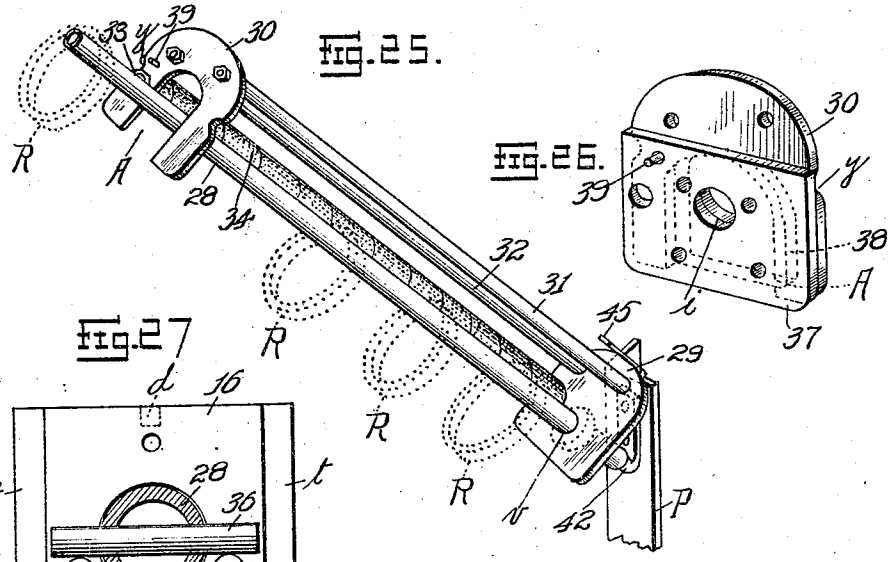


Fig. 26.

Fig. 27

Fig. 28.

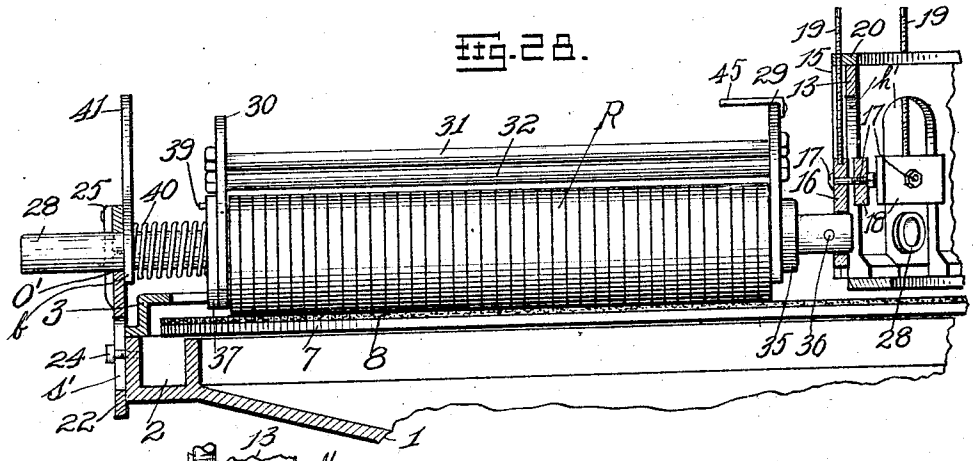
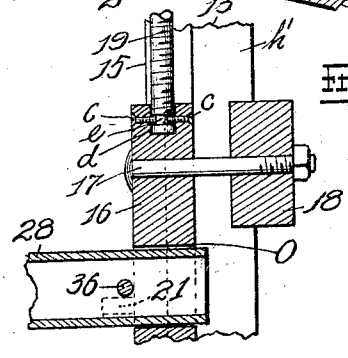


Fig. 29.



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UNITED STATES PATENT OFFICE.

JOHN B. KRONABLE, OF ST. LOUIS, MISSOURI, ASSIGNOR TO McQUAY-NORRIS MANUFACTURING COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

GRINDING MACHINE.

1,419,740. Specification of Letters Patent. **Patented June 13, 1922.**

Application filed September 3, 1920. Serial No. 407,860.

To all whom it may concern:

Be it known that I, JOHN B. KRONABLE, a citizen of the United States, residing at St. Louis, State of Missouri, have invented certain new and useful Improvements in Grinding Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

The present invention is directed to improvements in emery grinding machines of the type usually employed for the rough-burring or fettling of metal castings, the improvement herein being specially designed for the rough-burring of individually cast metal piston rings of the concentric circular and non-circular types. The object sought by the invention is to provide means for operating on a plurality of ring blanks with a view not only of reducing the time and labor usually consumed where rough-burring by hand is resorted to, but of securing uniform results as to all the rings treated. The piston rings herein referred to are of the split or open type, which, as well understood in the art, depend on the resilience of the metal for their effective service as packing rings, the outward spring of the metal causing the outer face of the ring to exert the desired radial pressure against the walls of the cylinder in which the ring is intended to operate. As well understood in the art, a piston ring should exert uniform radial pressure against the walls of the cylinder when in service; and in the types of ring referred to, this uniformity, when the ring is once properly contoured, is best maintained by imparting to the ring a uniform thickness or cross-section throughout its entire circumference. This desired object is attained by my improvement, all the rings fettled or ground in the machine being brought to a uniform cross-section when the fettling operation is concluded. The principle involved in the grinding operation is that of subjecting the rough surfaces of the rings to be treated or fettled to the abrading action of a grinding member or disk moving in a given path, said surfaces being held in yielding and rubbing contact with the abrading face of said moving disk through the instrumentality of a vertically movable weighted member responding to gravity (or its equivalent), the rings treated being free to revolve but at a slower (or different) rate of speed than the grinding disk in order to shift their points of contact therewith during the grinding or fettling operation, a differential in speed between the peripheries of the rings and the grinding surface of the disk engaged thereby being maintained until the several rings have been reduced to a substantially uniform thickness or dimension transverse to the face operated on. In the present embodiment of the invention use is made of a grinding disk of a conventional emery-grinding machine of the disk type well known in the art, the weighted member by which the rings (ring blanks) under treatment are maintained in firm contact with the disk being preferably in the form of a pipe over which the rings are loosely strung, the pipe having free vertical play within the rings during the fettling operation. The rings in their rotary movement over the abrading surface of the disk are guided and kept in alinement by suitable antifriction rollers, the invention proper being in the nature of an attachment to a standard emery-grinding machine of the general character referred to. The advantages of the improvement will be fully apparent from the following detailed description in connection with the accompanying drawings in which—

Figure 1 represents a perspective of a conventional disk-grinding machine showing my invention applied thereto; Fig. 2 is a middle vertical longitudinal section with parts in elevation; Fig. 3 is a perspective of the beam or bridge-bar spanning the guard ring surrounding the grinding disk; Fig. 4 is a horizontal section through the central supporting cylinder or mounting on the line 4—4 of Fig. 6, only one-half of the cylinder being shown and the adjustable bearing blocks being omitted; Fig. 5 is a top plan of the central supporting cylinder and of the ring or center platform of the bridge-bar carrying the same, parts being in section; Fig. 6 is an elevation of one half of the central supporting cylinder showing the ring of the bridge-bar to which the same is secured, and the ring surmounting the cylinder, the adjustable bearing blocks and guide plates for same being omitted; Fig. 7 is an elevation of Fig. 5, parts being in section; Fig. 8 is a side elevation of the frame or cage in which the rings to be treat-

ed are confined, parts being broken away; Fig. 9 is a front elevation or end view of Fig. 8; Fig. 10 is a perspective of the outer adjustable supporting plate or bearing for the ring, cage or frame; Fig. 11 is a perspective of the inner adjustable bearing block for the ring frame; Fig. 12 is a face view of the outer end wall of the ring frame or cage; Fig. 13 is a face view of the inner plate of the removable section closing the opening formed by the cut-away portion of the outer end wall of the ring cage; Fig. 14 is a face view of the outer plate of the removable section closing the opening of the outer end wall of the ring cage; Fig. 15 is a side or edge view of the parts shown in Figs. 12, 13, and 14 assembled; Fig. 16 is a middle vertical section through the assembled parts shown in Fig. 15; Fig. 17 is a face elevation of the inner end or terminal wall of the ring cage; Fig. 18 is a cross-section taken through the ring cage on the line 18—18 of Fig. 23; Fig. 19 is a top plan of the inner end of the ring cage or frame; Fig. 20 is a top plan of the outer end of the ring cage or frame; Fig. 21 is a perspective of the removable stop handle or bearing engaging the outer end of the tension spring which controls the removable section of the outer end wall of the ring cage or frame; Fig. 22 is a perspective of the outer end of the central supporting pipe of the ring cage, showing one of the transverse slots which receives one of the fork arms of the stop handle shown in Fig. 21; Fig. 23 is a vertical longitudinal section through the ring frame or cage on the line 23—23 of Fig. 9, showing in position the piston rings to be ground or fettled; Fig. 24 is an enlarged section on the order of the bottom portion of Fig. 23 showing in an exaggerated way the surface irregularities on the outer faces of the piston rings to be ground; Fig. 25 is a perspective of the ring cage or frame showing the manner of charging the frame with the piston rings to be treated; Fig. 26 is a perspective of the assembled parts shown in Fig. 15; Fig. 27 is an outer face view of one of the inner vertically adjustable bearing blocks for the ring cage, showing in cross-section the inner supporting pipe of the cage and the cross pin by which rotary displacement of the pipe (and of the cage) is prevented; Fig. 28 is a side elevation of the ring cage with its complement of rings, with the terminal supporting bearings and the grinding disk in section; and Fig. 29 is an enlarged vertical sectional detail through the adjustable bearing and the inner end of the supporting pipe of the cage, the plane of section being on the line 29—29 of Fig. 7.

Referring to the drawings, 1 represents a suitable base terminating at the top in an annular dust-channel 2 to the top of which a guard ring 3 is bolted, the dust channel being connected by pipe sections 4 to a manifold 5 extending partly around the base and communicating with a suitable exhauster (not shown). Secured to the top of a vertical driving spindle 6 is a horizontally rotating grinding disk 7 provided with a layer of emery cloth 8, the disk overlapping and clearing the inner vertical wall of the dust channel 2 (Fig. 2) whereby the dust as it leaves the disk is drawn into the channel and out through the manifold 5. The spindle 6 is provided with a bevel gear 9 meshing with a similar gear 10 at the inner end of the shaft 11 of an electric (or other) motor M, the several parts alluded to constituting the main elements of a well known type of horizontal disk grinder, and further description thereof is therefore unnecessary.

Spanning diametrically the grinding disk 7, and having its ends secured to the guard ring 3, is a beam or structural bridge member 12 T-shaped in cross-section, the same being formed with a central ring or platform *a* disposed about the rotation axis of the disk, the web or rib *w* of the member being preferably continued across the opening of the platform so as to impart stiffness to the beam. Screwed to the platform *a* is a supporting cylinder or mounting 13, the same being formed with two diametrically disposed shallow recesses *h* to receive the rib *w* of the beam 12, and being further provided with a series (six in the present example) of vertically elongated arched recesses *h'* open at the bottom, the base of the cylinder being preferably thickened to receive the screws 14 (Fig. 7) by which the same is secured to the ring platform *a*. Secured to the periphery of the cylinder 13 at points between the recesses *h'* are plates 15, 15', formed with lateral recesses *r*, the plates 15' being substantially one-half the width of the plates 15, on account of their proximity to the beam 12 (Fig. 4), the presence of the beam necessitating the mounting of a narrow plate on either side of the web *w*. The recesses *r* loosely receive the tongues *t* of the vertically adjustable bearing blocks 16, said blocks being further connected by means of bolts 17 extending through the recesses *h'* to the complementary guide blocks or washers 18 recessed on the sides to partly enter the recesses *h'* and partly to bear against the inner walls of the hollow cylinder 13 (Fig. 5), the members 16 and 18 moving as a unit with any vertical adjustment of the bearings 16. The washers 18 are not indispensable since the bearings 16 are very well guided by the tongues *t*, and recesses *r* of the outer guide plates 15 (15'), though the addition of the washers 18 makes a more rigid construction. Vertical adjustment is imparted to the bearings 16 by means of adjusting screws 19 mounted in the outer overhanging portion of a ring 20

screwed to the upper end of the cylinder 13, the lower end of the adjusting screw entering loosely a socket *d* in the block 16, a peripheral groove *e* on the screw in the socket receiving the inner ends of the stems of the screws *c* whereby the adjusting screw becomes loosely coupled to the bearing block (Fig. 29). The adjusting screw 19 terminates at the top in a square end for receiving the socket of a wrench or handle (not shown) by which the screw is turned in proper direction to either lower or raise the bearing 16. The bearing 16 is provided with an opening O bounded on the outer face by the horizontal pins 21, 21, for a purpose to presently appear. In the example before us there are six adjustable bearing blocks 16 surrounding the supporting cylinder 13, each bearing having cooperating therewith an adjustable plate or bearing 22 secured to the outer vertical wall of the dust-channel 2 by means of stud-bolts 23 the stems of which traverse the vertically elongated slots *s* formed in said plate on either side of the center thereof, a central parallel slot *s'* being traversed by a pin or stud 24. By loosening the nuts on the stud-bolts the plate 22 may be adjusted vertically to any position and then clamped tightly as clearly apparent from the drawings and well understood in the art. The upper edge of the plate (Fig. 10) is formed with a semi-circular depression; and hinged to a bracket 25 at one of the upper corners of the plate is an arm 26 likewise formed with a semi-circular depression, the two depressions, when the arm 26 is lowered coming together and forming a circular opening O' of the same diameter as the opening O in the bearing block 16, proper adjustment of the block 16 and plate 22 bringing the axes of the openings O, O', into the same horizontal plane. The arm 26 when dropped into position against the upper edge of the plate 22 passes behind a guard 27 at the opposite upper corner of the plate. The opening O of the block 16 receives the inner end of the supporting pipe (or rod) 28 on which the piston rings to be ground are originally strung or when being charged into the frame or cage in which they are confined during the grinding or fettling operation, the outer end of the pipe resting in the semicircular depression in the upper edge of the plate 22 forming the lower half of the circular opening O', said opening as previously indicated being completed with a movement of the arm 26 against the edge of the plate 22 (Fig. 10).

The frame or cage in which the rings are confined during the grinding operation comprises an inner terminal wall or plate 29, an outer terminal wall 30, parallel connecting rods 31, 32, and 33, the latter being provided with anti-friction rollers 34, extending the full distance between the end plates 29, 30. The pipe 28 projects rearward through an opening *v* of the wall 29 a suitable distance, said pipe when once adjusted being set-screwed to a ring 35 screwed to the rear face of the wall 29 and receiving said pipe, the projecting portion of the pipe being provided with a cross pin 36 the ends of which rest on the pins 21, 21, projecting from the outer face of the bearing block 16 and preventing the pipe 28 from rotating during the grinding operation. The pipe 28 extends longitudinally forward beyond the fixed front wall section 30, the latter being cut away so as to leave an arch shaped opening A (Fig. 12) which, during the grinding operation is closed by the removable sliding section composed of an outer plate 37 of sufficient dimensions to overlap the opening A and bear against the outer face of the wall 30, and an inner plate 38 secured to the plate 37, the inner plate being contoured to enter and close the opening A and of a thickness to slightly project beyond the inner face of the wall 30 when the plate 37 of said removable section engages the outer face of said wall (Figs. 15, 16, 20, 23). The plates 37, 38, have registering openings *i*, *i*, for the free passage of the pipe 28 therethrough, the wall section 30 being provided with a guide pin 39 passing freely through an opening *m* in the plate 37 for guiding the lattter during the closing movement of the removable section of the front wall of the cage. During the grinding operation the removable section (plates 37, 38,) of the outer end wall of the cage is held in proper engagement with said wall to close the opening A thereof, by means of a coiled expansion spring 40 passed loosely over the outer projecting portion of the pipe 28, one end of the spring bearing against the plate 37 and the opposite end bearing against a stop plate or handle 41 detachably secured to the pipe 28 by the arms of the fork *b* formed on the handle and the arcuate slots *u* cut in the pipe at points diametrically opposite one another, the arms of the fork when inserted into their respective slots locking the handle to the pipe. For convenience, I provide a suitable standard or post P, in proximity to the grinding machine, the post having secured thereto an upwardly inclined pin or finger 42 over which the inner end of the pipe 28 is passed, the finger holding the ring cage at a convenient inclination for charging the same with the ring blanks to be ground. The charging position of the cage is shown in Fig. 25, the stop handle 41, spring 40, and removable section (37, 38,) of the front terminal wall of the cage having been removed to permit the charging of the rings into the cage. The rings R are slipped over the upper free end of the pipe 28 and slide down the pipe, a sufficient number of the rings being intro-

duced to fill the cage the entire distance between the walls 29 and 30. The required number of rings being strung on the pipe 28, the operator then slips over the pipe 28 and through the rings R a tubular sleeve or pipe 43 of larger diameter than the pipe 28 but of smaller diameter than the rings, said pipe 43 being of sufficient weight to hold down the complement of rings in firm engagement with the grinding face of the grinding disk, the relative diameters of the pipes 28 and 43 and of the rings R being such as to allow free vertical movement or play of the pipe 43 around the pipe 28 and inside the rings R during the grinding operation, (Fig. 18), it being understood that the length of the pipe 43 is such as to leave the necessary clearance between the ends of the pipe and the terminal walls of the cage (Fig. 23). When the cage has been charged with rings, the removable section (37, 38,) of the outer fixed wall 30 of the cage is slipped over the outer end of the pipe 28 and pushed inward sufficiently to close the opening A of said fixed wall, the plate 38 of said movable section under the circumstances projecting slightly beyond the inner face of the wall 30 and bearing against the outer terminal ring of the series, the inner terminal ring bearing against the inner face of the wall 29. The operator next slips the spring 40 over the pipe 28 and against the plate 37, and after compressing the spring the required degree he slips the fork *b* into the slots *u* of the pipe, thereby holding the spring 40 while under tension against the removable section of the outer wall of the cage. The removable yielding wall section (plates 37, 38,) under the tension or resilience of the spring operates as a brake upon the complement of rings confined between said section and the inner wall 29 of the cage; and when the outer faces of the rings are brought in contact with the grinding surface of the disk, this braking action in a measure retards their rotation, the rings traveling peripherally at a lower rate of speed than the surface of the grinding disk, this differential in speed causing a progressive shifting of the points of contact of the rings with the disk and resulting in the abrasion or grinding of the outer faces of the rings. The retarding of the rings in their rotation however is not altogether due to the braking action of the spring 40, the weight of the pipe 43 and the friction between the rings and the rollers 34 likewise contributing to that end as will be clearly apparent from an inspection of Fig. 18. The machine is preferably provided with a dust shield or hood H adjacent each ring cage, said shield being of sheet iron bent into the desired shape, the manner of fastening the shield in position being immaterial. In the present example I mount a rod 44 radially over the grinding disk, fastening the inner end of the rod to a plate 15, the opposite or outer end being screwed to the guard ring 3 (Fig. 1). Over the rod I then deposit the sheet metal shield fastening the outer edges of the shield to the guard ring.

The operation of the machine may best be described by a reference to Figs. 1, 18, 23, 25, and 28, and is substantially as follows: The stop-handle 41 is first detached from the supporting pipe 28 of the ring cage by pulling the forked end thereof out of the slots *u*, then the spring 40 is slipped off the outer end of the pipe, after which the removable section (plates 37, 38,) of the outer wall of the cage is slipped off the pipe in the same manner, and deposited on a table or work bench within easy reach of the operator. To facilitate the withdrawal of the removable wall section referred to, the fixed wall 30 is preferably provided with lateral finger depressions *y* through which the operator may insert his fingers to secure a purchase on the back of the plate 37 (Figs. 12, 15). Thereupon the gravity pipe 43 with its complement of rings fettled from a previous operation is dropped out of the frame through the opening A into a receptacle for receiving the rings, said gravity pipe being restored to the cage as presently to be seen. The removal of the parts referred to leaves the cage proper in readiness to be charged with a fresh lot of rings. To do this the operator passes the rear end of the supporting pipe 28 over the peg or finger 42 on the post P, the cage being thus supported at a suitable incline for charging. The operator then slips the rings R over the upper end of the pipe, the same sliding down the pipe through the opening A of the wall 30, a sufficient number of the rings being strung on the pipe to fill the cage between the walls 29 and 30. Thereupon the operator takes the gravity pipe 43 from the receptacle into which it had been dumped with the rings of the previous operation, and slips the same over the pipe 28 and inside the lot of rings strung thereon, thereby bringing all the rings over the gravity pipe, the latter being of a length so as to nicely clear the end walls of the cage (Fig. 23). The operator then passes the removable section (plates 37, 38,) of the outer wall 30 over the free end of the supporting pipe 28 closing the opening A, after which he slips the spring 40 back on the said pipe and locks the spring (after first compressing it) to the pipe by restoring the stop handle 41 to its position on the pipe, this being accomplished by passing the arms of the fork *b* through the slots *u*. The cage being now charged with a fresh lot of rings the same is mounted over the grinding disk 7, the operator picking up the cage by seizing the front end of the supporting pipe 28 with one hand, and the arm or handle 45

with which the wall 29 is provided with the other hand, then inserting the rear end of the pipe into the opening O of the bearing block 16 a sufficient distance to cause the ends of the cross pin 36 to rest on the pins 21, 21, projecting from the block, the front or outer end of the pipe being deposited in the semicircular depression on top of the plate or bearing 22, after which the lever 26 may be dropped over the pipe (Figs. 1, 10). The bearings 16 and 22 are of course previously adjusted to permit the gravity pipe 43 to bear down on the rings and grinding disk without coming in contact with the inner supporting pipe 28 (Fig. 18), this adjustment being effected through the medium of the adjusting screw 19 for the bearing 16, and the stud bolts 23 for the plate or bearing 22, the pipe 28 being mounted horizontally or parallel to the grinding surface of the grinding disk. The cage with its rings mounted as described conforms substantially to the showing in Figs. 18, 23, and 28. Assuming that the grinding disk rotates clockwise (Figs. 1, 18), it is apparent that it will tend to impart rotation to the complement of rings in the cage clockwise (Fig. 18), the rollers 34 engaged by said rings keeping the latter in alinement. It will be remembered that the spring 40 acting through the removable yielding section of the outer wall of the cage crowds the rings together and causes the inner ring of the series to bear against the inner face of the wall 29, the spring thus operating as a brake and in a measure retarding the rotation of the rings. In this rotation the rings tend to carry the gravity pipe 43 upward along the ascending arc of the inner faces of the rings, the pipe however tending all the time to roll down or back to its lowest position. This action of the gravity pipe likewise contributes to retard the otherwise clockwise rotation of the rings. Finally, the friction between the rings and the peripheries of the rollers 34 constitutes another contributing cause to retard the rings in their rotation, the result being that there will be a differential between the peripheral speeds of rotation of the rings and the speeds of rotation of the portions of the grinding surface of the disk with which the rings are in contact. This differential in speed results in the shifting of the points of contact of the rings with the grinding surface of the disk and necessarily a mutual rubbing and abrasion of the surfaces results; and while the object is to grind the rings, it is obvious that the emery cloth layer 8 will also in time wear away and must be renewed. It was pointed out above that uniform radial pressure of a split ring against the walls of the cylinder in which the ring is intended to operate depended on uniformity of cross-section or thickness once the ring was properly contoured; and that one of the objects sought was to treat the rings in such a way as to bring them down to a uniform cross-section. This result is accomplished by the gravity pipe 43, its action being illustrated in a slightly exaggerated form in Fig. 24. In that figure it will be seen that two of the rings by reason of rough formations or protuberances x on the outer faces of the rings will have an increased thickness in the region of these formations, this extra thickness lifting the pipe 43 out of contact with the remaining rings. Thus the full weight of the pipe is on the two thicker rings and these two will be temporarily subjected to the greatest grinding action, the remaining rings bearing on the grinding disk only with their own weight and hence subjected to considerably less abrasion. By the time these protuberances or swells x have been ground off, the rings will be down to substantially uniform thickness, when the pipe 43 will contact with, and bear with uniform pressure on all the rings. From that moment a slight further treatment will have fettled the entire series of rings to a substantially uniform depth and all the rings will be practically uniform in thickness when taken off the machine. This leaves the rings in ideal condition for splitting and final grinding and finishing as well understood in the art. When the rings have been sufficiently fettled the operator picks up the cage from its supports (the lever 26 being first thrown back to release the pipe 28), removes the handle 41, spring 40, and the removable section of the outer end wall of the cage, and dumps out the pipe 43 with its rings. This leaves the cage clear for another lot of rings, the same being charged into the cage as previously described.

The device is obviously susceptible of considerable change without a departure from the nature or spirit of the invention. It is obvious that the portions of the grinding surface of the disk nearest the rotation axis of the disk will travel at less speed than the portions nearer the periphery of the disk, the angular velocities thereof being however the same. It is for this reason that a plurality of anti-friction rollers 34 are employed, the rollers nearer the axis of the disk conforming to the lower speed necessarily imparted to the rings R engaging the same, the outer rollers and the rings cooperating therewith on the other hand rotating faster. This difference in speed between the several rings will cause a slipping and rubbing between their contacting sides as obvious, but since the spring 40 is of comparatively low tension the friction due to the slippage is negligible. In fact the tension of the spring 40 must not be so great as to interfere with the free gravity action of the pipe 43. Features shown but not alluded to are well un-

derstood in the art and require no description in the present connection.

Having described my invention what I claim is:

1. In combination with a rotating grinding disk, a fixed support mounted adjacent the grinding surface of the disk, a ring-supporting pipe mounted loosely on said support and movable freely to and from the disk, said pipe freely traversing the rings and holding the same against the grinding surface of the disk, whereby rotation is imparted to the rings by the disk and the peripheral speed thereof retarded by the pipe to cause a rubbing between the contacting surfaces of the rings and disk.

2. In combination with a rotating grinding disk, a member disposed horizontally across and adjacent to the grinding surface of the disk, a pipe loosely encompassing said member and having free vertical play thereon, said pipe supporting a series of rings loosely strung thereon and holding said rings down upon the grinding surface of the disk, whereby rotation is imparted to the rings about the pipe and about the axis of the longitudinal member, and their outer faces abraded by the grinding surface of the disk, and a member disposed parallel to the pipe and engaging the outer faces of the rings for guiding and aligning the latter in their rotation.

3. In combination with a rotating grinding disk, a member disposed horizontally across and adjacent to the grinding surface of the disk, a pipe loosely encompassing said member and having free play thereon in a vertical plane, said pipe supporting a series of rings to be ground and holding said rings down upon the grinding surface of the disk, whereby rotation is imparted to the rings and their outer faces abraded by the disk, a cylindrical rod disposed adjacent and parallel to the longitudinal member, and anti-friction rollers on said rod forming bearings for the outer faces of the rings for guiding and aligning the same in their rotation.

4. An attachment for disk grinding machines, comprising a frame having terminal walls, one of said walls having a cut-away portion, a removable sliding section for closing the opening formed by said cut-away portion, a longitudinal pipe secured at one end to one of the terminal walls and extending through the frame and through and beyond the removable section of the opposite wall, a gravity sleeve passed loosely over the pipe aforesaid and free to play thereon in a vertical plane between the terminal walls of the frame, said sleeve being adapted to receive thereon a series of rings to be ground, the inner face of the removable section aforesaid projecting slightly beyond the corresponding face of the wall having the cut-away portion and engaging the adjacent terminal ring of the series, a detachable stop or abutment carried by the outer projecting end of the longitudinal pipe aforesaid, a spring interposed between said abutment and the removable wall section for holding the section against the rings, a cylindrical rod disposed between the terminal walls of the frame parallel to the longitudinal pipe, and a series of rollers on the rod for engaging the outer faces of the complement of rings and guiding the rings in their rotation about the sleeve.

5. In combination with a rotating grinding disk, a member mounted adjacent the grinding face of the disk, a ring-supporting weighted member mounted loosely on the support and having free vertical play thereon to and from the disk, said member freely traversing the rings and holding the same with their outer faces against the grinding face of the disk, a fixed abutment engaging the side of the last ring of the series at one end, and a yielding abutment engaging the side of the last ring of the series at the opposite end, thereby operating as a brake for the rings and retarding the same in their rotation and causing abrasion of the outer faces of the rings by the grinding face of the disk.

6. In combination with a rotating grinding disk, a member for receiving thereon a complement of rings to be ground, a support for said member positioned to permit the outer faces of the rings to be applied to the grinding surface of the disk, a fixed abutment engaging one end of the series of rings, and a yielding abutment applied to the opposite end whereby the peripheral speed of rotation of the rings lags behind the speed of the portions of the grinding face of the disk engaged by the rings, and abrasion of the outer faces of the rings results.

7. An attachment for grinding machines, comprising an open frame having terminal walls, one of the walls having a cut-away portion, a rigid supporting member secured at one end to one of the end walls and passing through the cut-away portion of the opposite wall and extending beyond said wall, a ring-supporting gravity operating pipe mounted loosely on said supporting member and having free play between the terminal walls aforesaid, a movable abutment passed freely over the outer projecting portion of the supporting member and closing the opening formed by the cut-away portion of the first mentioned terminal wall of the frame, a coiled spring on the supporting member having its inner end engaging the movable abutment, and a stop-piece or plate detachably secured to the supporting member and forming a fixed bearing for the outer end of the spring, the

opposite ends of the supporting member being extended respectively beyond the stop-piece and the first mentioned wall of the frame for mounting said member in suitable bearings in proximity to a rotating grinding disk.

8. In combination with a member having a grinding surface moving in a fixed path, means for supporting a complement of rings disposed adjacent to one another in position to cause their outer faces to frictionally engage the grinding surface and have imparted thereto a rotation by said grinding member, a fixed wall engaging the terminal ring at one end of the series, and a spring-controlled movable wall engaging the terminal ring at the opposite end of the series, the braking action of the spring operating to produce a differential between the speed of rotation of the rings and of the travel of the grinding member, and causing a rubbing action between the rings and grinding surface aforesaid.

9. In combination with a horizontally rotating grinding disk, a pipe mounted across the disk and adapted to receive a complement of rings loosely thereon and held with their outer surfaces against the grinding surface of the disk by the downward pressure of said pipe, and means for maintaining the rings in alinement during the grinding operation.

10. In combination with a horizontally rotating grinding disk, an adjustable supporting member extending radially across the disk, a pipe loosely passed over said member and having a free vertical play thereon, said pipe being adapted to receive a complement of rings of larger diameter than the pipe and maintained with their outer faces against the grinding disk by the weight of the pipe, a fixed cylindrical rod mounted parallel to the supporting member, and rollers on said rod engaging the outer faces of the rings at points removed from the points of contact of the latter with the grinding disk for holding the rings in alinement.

11. In combination with a horizontally rotating grinding disk, an adjustable supporting member extending radially across the disk, a pipe loosely passed over said member and having a free vertical play thereon, said pipe being adapted to receive a complement of rings of larger diameter than the pipe and maintained with their outer faces against the grinding disk by the weight of the pipe, a fixed cylindrical rod mounted parallel to the supporting member, rollers on said rod engaging the outer faces of the rings for guiding, and holding the same in alinement, a fixed wall forming an abutment for one end of the series of rings, and a spring-controlled yielding abutment engaging the opposite end of the series of rings and operating as a brake therefor to retard the rings in their rotation.

12. In combination with a horizontally rotating grinding disk, a beam spanning the same diametrically and spaced therefrom, a suitable mounting on the beam disposed about the rotation axis of the disk, a series of vertically adjustable bearings on said mounting, a corresponding series of vertically adjustable bearings disposed about the periphery of the disk and radially aligned with the first mentioned bearings, suitable ring-confining frames disposed between the radially aligned bearings, and means in the frames for holding the rings against the grinding surface of the disk by pressure supplementing the weight of the rings.

13. In combination with a horizontally rotating grinding disk, a beam spanning the same diametrically and spaced therefrom, a hollow cylinder secured to the beam about the rotation axis of the disk, a series of guide plates and vertically adjustable bearings in tongue and groove connection with one another, a ring capping and overhanging the cylinder, adjusting screws leading from the ring and coupled to the adjustable bearings, the latter being provided with openings alined with the adjusting screws, a series of vertically adjustable bearings adjacent the periphery of the disk and radially alined with the first mentioned bearings, a ring-confining cage, a supporting pipe therefor terminating at one end in a cross pin, pins projecting from the first mentioned bearings on opposite sides of the openings thereof aforesaid and operating to support the ends of the cross pins of the supporting pipes upon the insertion of the ends of the pipes into the openings of the bearings, and a gravity operating member between the bearings of each cage to hold down the rings to be ground against the surface of the grinding disk.

14. In combination with a grinding disk rotating in a horizontal plane, a supporting pipe extended radially across and above the grinding surface of the disk, a sleeve or outer pipe of larger diameter passed over the first pipe and serving as a direct support for a complement of rings of larger diameter, said sleeve or outer pipe operating with its weight to hold down the rings with their outer faces in contact with the grinding surface of the disk.

15. In a machine of the character described, a ring cage having an inner extended supporting member, a fixed terminal wall at one end of the cage, a wall at the opposite end comprising a fixed section having an opening traversed by the supporting member aforesaid and a movable section loosely mounted on the supporting member and operating to close the opening with an inward movement of said section, resilient means on

the supporting member engaging the outer wall of the movable section, said movable section operating as a yielding abutment or brake against the complement of rings charged into the cage between said movable section and the fixed terminal wall opposite thereto.

16. In combination with a rotating grinding disk, means for supporting a complement of rings disposed adjacent to one another in position to cause their outer faces to frictionally engage the grinding surface of the disk and have imparted thereto a rotation by said disk, a fixed abutment engaging the terminal ring at one end of the series of rings, and a movable abutment under resilient control, engaging the terminal ring at the opposite end of the series and exerting a braking action on the rings, said braking action operating to produce a differential between the peripheral speeds of rotation of the rings and the speed of rotation of the disk, and causing a rubbing or abrasion between the outer faces of the rings and the grinding surface of the disk.

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

JOHN B. KRONABLE.

Witnesses:
EMIL STAREK,
PAUL R. DOLVIN.