Oct. 9, 1934. B. R. PURVIN 1,976,035

GRINDING MACHINE

Filed Dec. 9, 1932 2 Sheets-Sheet 1

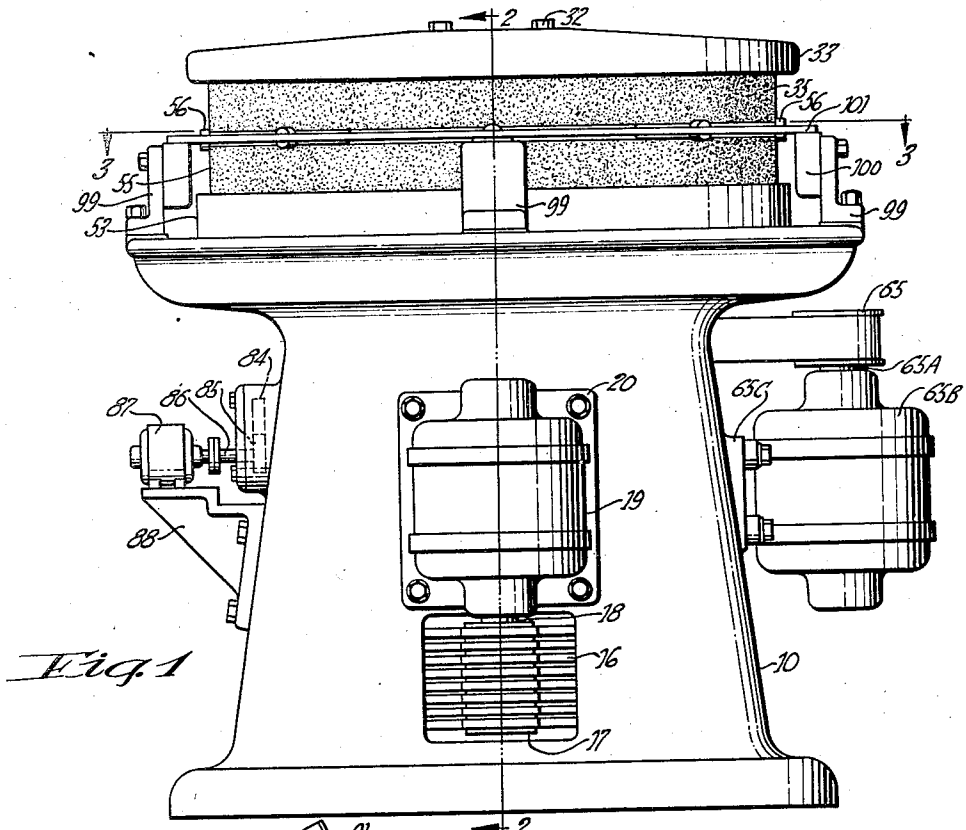

Fig. 1

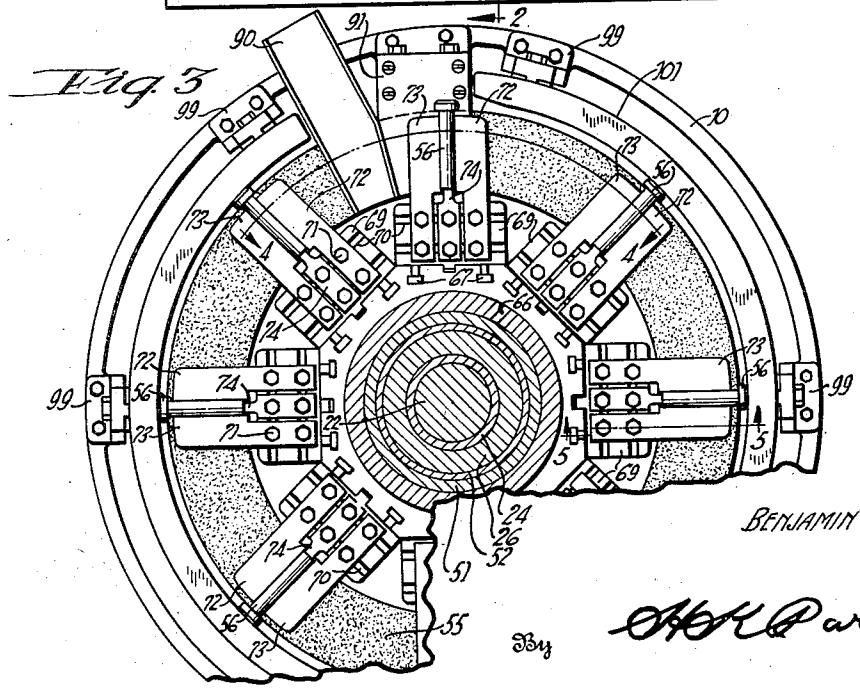

Fig. 3

Inventor
BENJAMIN R. PURVIN

By H. K. Parsons

Attorney

Oct. 9, 1934. B. R. PURVIN 1,976,035

GRINDING MACHINE

Filed Dec. 9, 1932 2 Sheets-Sheet 2

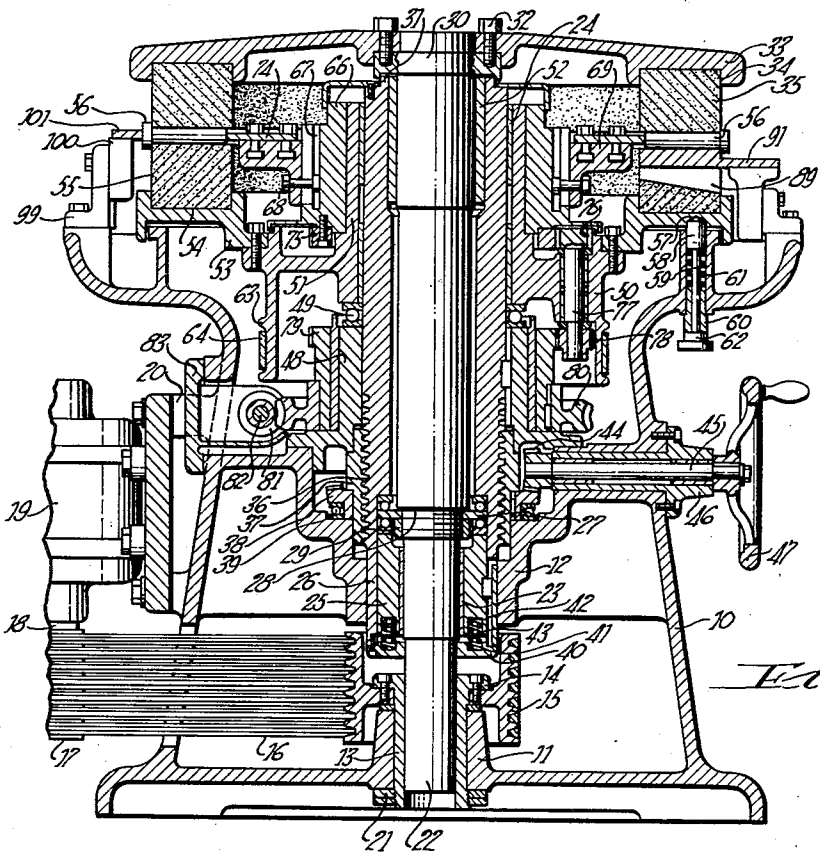

Fig. 2

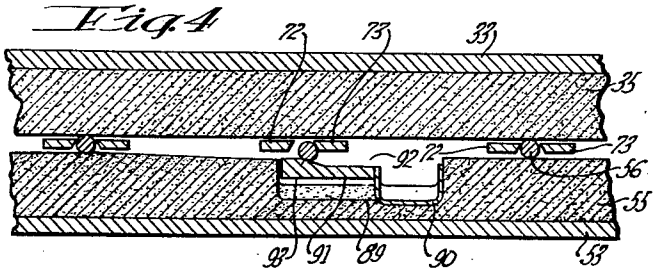

Fig. 4

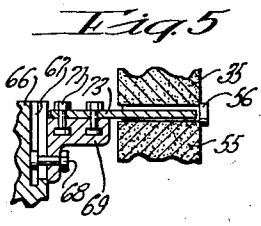

Fig. 5

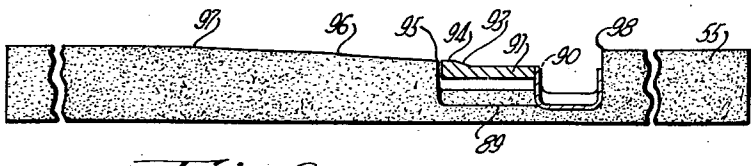

Fig. 6

Inventor
BENJAMIN R. PURVIN

By H. K. Parsons

Attorney

Patented Oct. 9, 1934

1,976,035

UNITED STATES PATENT OFFICE

1,976,035

GRINDING MACHINE

Benjamin R. Purvin, Cleveland, Ohio, assignor to Cincinnati Grinders Incorporated, Cincinnati, Ohio, a corporation of Ohio

Application December 9, 1932, Serial No. 646,553

16 Claims. (Cl. 51—129)

This invention relates to improvements in grinding machines and especially to improvements in centerless grinders.

An object of the invention is the provision of a centerless grinder particularly adapted for the continuous production of circular work pieces within accurate limits of tolerance.

Another object of the invention is the provision of a centerless grinding machine for producing all types of work pieces, such as, shoulder, straight, and tapered work pieces having a surface of revolution without the necessity of completely re-arranging the machine.

A further object of the invention is the provision of a machine as above specified that requires a minimum of parts and is of a simple yet rugged design.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in conjunction with the accompanying drawings, forming a part thereof, and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

In the drawings:

Figure 1 is an elevational view of a grinding machine embodying the improvements of this invention.

Figure 2 is a vertical sectional view taken substantially on line 2—2 of Figure 1.

Figure 3 is a horizontal view partly in section and partly in elevation, as seen from line 3—3 on Figure 1.

Figure 4 is a fragmentary sectional view as seen from line 4—4 on Figure 3.

Figure 5 is a fragmentary sectional view on line 5—5 of Figure 3.

Figure 6 is a developed view of the work rotation control wheel.

Throughout the several views of the drawings similar reference characters have been employed to denote the same or similar parts.

In general the machine comprises a pair of ring like wheels or members disposed in horizontal planes each composed of abrasive materials. One of said wheels is rotated at a high grinding rate of speed while the other is stationary to support the work and control its rotation during the grinding operation. The wheels are so arranged as to effect a rapid approach of the work and grinding wheel followed by a relatively slow relative feed during the actual grinding operation, whereupon the work and grinding wheel are actuated relative to one another at a rate to provide the desired finish on the work. The normally stationary wheel may, however, be rotated at a rapid rate during the truing of the operative face thereof. There is also provided an adjusting mechanism for properly positioning the wheels with respect to one another and for taking up inevitable wear on the operative surfaces of said wheels.

Specifically, the machine comprises a bed 10 in the nature of a cylindrical column centrally of which is formed bearing brackets 11 and 12. The bracket 11 is disposed near the base of the column and has journaled therein a sleeve 13 which has a flange 14 at one end thereof. Secured in any desirable manner to the flange 14 is a pulley 15, here shown as a sheave of the multiple V-belt type. Extending about the sheave 15 are a plurality of belts 16 which are in turn trained about a sheave or pulley 17 keyed or otherwise secured to the motor shaft 18. The shaft 18 is associated with a prime mover or motor 19 having its base bolted or otherwise secured to a pad or lugs 20 projecting from the outer surface of the bed or column 10. To take up any play between the bracket 11 and the driving pulley sleeve 13, the outer end of the sleeve is threaded to receive lock nuts 21.

Keyed or otherwise secured to the sleeve 13 for rotation therewith is a driving shaft or spindle 22 which extends centrally through the bed or column 10 and is disposed within bearing members 23 and 24. The bearing sleeve 23 is disposed within a sleeve member 25 in turn enclosed within a counterbore in the lower end of a quill 26. The sleeve member 25 supports on its upper end one race of a double anti-friction thrust bearing 27 while the other outer race of this bearing bears against the base of the counterbore formed in the quill 26. The intermediate plate or race of the thrust bearing 27 is disposed against a shoulder 28 formed intermediate the ends of the shaft or spindle 22 and is secured thereto by means of a nut 29 threaded on the spindle. The upper bearing 24 is secured in a counterbore formed in the upper end of the quill 26.

The upper end of the spindle 22 is provided with a recessed flange 30 receiving in the recess a reduced nose 31 on the end of the quill 26 and the flange forms a seal to prevent coolant and other foreign particles from entering the bearing 24. Secured to the spindle flange 30 as by means of cap screws or the like 32, is the grinding wheel carrier 33 having formed on its under

surface a recess 34 in which is securely disposed the ring like grinding wheel 35.

From the foregoing it will be noted that the grinding wheel spindle 22 is amply supported and rotated for thereby rotating the grinding wheel at the usual high grinding rate of speed.

In order to vary the position of the grinding wheel 35 as respects the bed or column 10, the quill 26 is adapted to be axially adjusted carrying with it the spindle 22 and grinding wheel 35. For this reason the quill 26 is provided intermediate its end and exteriorly thereof with screw threads 36 received in a rotatable nut member 37. Keyed or otherwise secured to the nut 37 is a bevel gear 38 providing on its under surface a flat bearing. Disposed between this flat bearing of the bevel gear 38 and an opposed bearing surface formed on the column bearing bracket 12 is an anti-friction thrust bearing 39 which reduces the friction incident to the rotation of the nut 37. In order to take up any back lash that there may be in the thrust bearing between the spindle and the upper seat of bearing 27 and also between the spindle and the lower seat, there is provided a spring supporting plate 40 secured in any desirable manner to the lower end of the quill 26, the plate having formed therein a plurality of spring seats 41 which are opposed to suitable cavities or spring pockets 42 formed in the sleeve member 25 that is disposed within the counterbore in the lower end of the quill 26. Received in the spring seats 41 and cavities 42 are springs 43 which are of the expansion type and tend to shift the sleeve member 25 upwardly as respects the quill 26, as seen in Figure 2, and thereby eliminate any lost motion or back lash between the quill and spindle.

The bevel gear 38 has meshing with it a bevel pinion 44 secured in any desirable manner to the inner end of a shaft 45 journaled in a bearing sleeve 46 carried by the bed or column 10. In order to rotate the shaft 45 the outer end thereof has secured to it a hand wheel 47. From the foregoing it will be noted that rotation of the hand wheel 47 in either direction will through the shaft 45, bevel pinion 44 and bevel gear 38 effect the rotation of the nut 37 and elevate or lower the quill 26 and parts carried thereby including the grinding wheel 35.

Secured to the upper surface of the column bearing bracket 12 is a supporting sleeve 48 forming one support for a thrust bearing 49 which has contacting with it on its other surface a bracket member 50. The bracket member 50 has integral therewith a sleeve or flange 51 which surrounds the quill 26 near its upper end and is spaced therefrom by bearing bushings 52. The bracket member 50 is provided with a radial flange to which is secured a ring like carrier 53 having formed in its upper surface a groove or way 54 in which is secured a ring like wheel 55 which may be composed of abrasive or other friction material, preferably abrasive. The upper face of the member 55 is opposed to the lower operative or grinding face of the grinding wheel 35 and it is between these faces that the work 56 is disposed. In operation the wheel 55 is held stationary while the wheel 35 is rotated and the wheel 55 thereby effects and controls the proper rotation of the said work 56.

In order to normally hold the wheel 55 stationary, the carrier 53 is provided with a socket 57 receiving the nose 58 of a plunger 59. The plunger 59 is shiftable through a bushing 60 carried by the bed or column 10 and the bushing constitutes a shoulder for a spring 61 which surrounds the plunger 59 and abuts with the nose 58 for shifting said nose into the recess 57. In order to disengage the plunger and recess, the plunger is provided with a knob 62.

When it is desired to true the operative face of the wheel 55, it must be rotated for which purpose the bracket member 50 is provided near its lower end with a pulley 63 which may be an independent member secured to the bracket member, or formed integral therewith, as shown in the drawing. Trained about the pulley 63 is a belt 64 in turn extending about a pulley 65 on the free end of a motor shaft 65A of a prime mover or electric motor 65B. The motor 65B is secured to a pad or lugs 65C extending from the bed or column 10. It will be understood that in order to rotate the bracket 50 and consequently the wheel 55 it is necessary to withdraw the plunger nose 58 from its socket 57 and hold the said plunger disengaged.

The work while being operated upon must be backed up in order to take the grinding thrust of the grinding wheel and to insure proper feed between the work and grinding wheel, it must be positively actuated relative thereto. For this reason the sleeve or circular flange 51 of the bracket member 50 has journaled thereon the work feeding mechanism comprising a turret like member 66, here shown as octagon in cross section, but it is to be understood that the turret may be provided with more or less than eight faces, as required. The turret 66 has formed in each face thereof a plurality of T-slots 67 for clamping bolts 68 which secure to each face thereof a work feeding and backing up bracket 69. These brackets are each duplicates of one another wherefore it is deemed sufficient if but one of them be described in detail. Accordingly, the bracket 69 is provided with T-slots 70 receiving bolts 71 for adjustably securing thereto the blades 72 and 73. The blades 72 and 73 are spaced from one another a distance equal to the diameter of the work to be operated upon whereby to receive between them the work. The bracket 69 in addition has secured to it intermediate the blades 72 and 73, an end stop 74 which engages the inner end of the work to limit the axial movement thereof radially of the operative face of the wheel 35.

From the foregoing it will be understood that the blades 72 and 73 are substantially universally shiftable to properly align them with the work to effect the proper engagement of the work and pusher blade. This universal adjustment of these blades being accomplished by shifting the bracket 69 relative to the face of the turret 66 for raising and lowering the blades as respects the face of the control wheel 55 while the blades are independently adjustable as respects the brackets to take care of different diameters of work.

As was noted above, during operation the turret 66 is rotated for shifting the work relative to the operative face of the grinding wheel, for which purpose the turret has secured to its lower surface a gear 75 meshing with a pinion 76 integral with or secured to a shaft 77 rotatably journaled in the bracket member 50. Secured to the other end of the shaft 77 is a pinion 78 of the same size as the pinion 76 which meshes with a gear 79. The gear 79 is rotatably journaled on the bracket sleeve 48 which in turn surrounds the quill 26. Keyed or otherwise secured to the gear 79 is a worm wheel 80 meshing with a worm 81 on one end of a worm shaft 82. The

worm shaft 82 is rotatably journaled in a bracket 83 carried by the bed or column 10. Secured to the worm shaft 82 and within the bracket 83 is a gear 84 meshing with a companion gear 85 on a shaft 86 which is in turn coupled to a motor 87 carried by a bracket 88 secured in any desirable manner to the bed or column 10.

From the foregoing it will be noted that the work is guided or rolled on the supporting surface of the wheel 55 while in operative engagement with the operative face of the wheel 35. It is to be understood that the rotation of the work and the feed thereof with respect to the face of the grinding wheel is at a relatively slow rate of speed.

In order to insert the work between the wheels and remove same therefrom, there is provided a loading and ejecting station, illustrated in Figure 4, which consists in undercutting or recessing the wheel as at 89 where there is placed a discharge chute 90 and a loading plate 91. The plate 91 has a low portion 92 on which the work is individually placed and an inclined portion 93 up which the work is moved to dispose same between the blades 72 and 73. Following the inclined portion 93 the plate has a flat surface 94 which terminates at the point 95 of the operative surface of the work control wheel 55. From the point 95 to the point 96, see Figure 6, the face of the wheel rapidly rises to effect engagement of the work with the face of the grinding wheel 35 and from the point 96 to the point 97 a slow rise is formed to gradually feed the work into the grinding wheel to effect the stock removal therefrom. From the point 97 to the discharge point 98 adjacent the discharge pan 90, the face of the wheel 55 is relatively flat or parallel with the face of the grinding wheel to permit a sparking out between the work and the wheel and to provide the desired finish on the work.

To guide shouldered work and the like below the shoulder thereof, the bed or column 10 has secured to its upper surface a plurality of brackets 99 to which are adjustably secured blocks 100. Secured to the upper surface of the blocks 100 is a ring 101 adapted to contact with the outer edge of the work 56 and hold same radially positioned as respects the grinding wheel and thereby insure the presentation of the work below the shoulder to the grinding wheel without engagement between the head or shoulder of the work and the outer periphery of the grinding wheel. In the event it is desired to grind straight work pieces, that is, work pieces having no shoulder, the pushing blade 73 is slightly skewed as respects the supporting bracket and thereby exerts a feeding component on the work axially of itself for thereby holding the inner end of the work against the end stop 74.

It is believed that the foregoing discloses the mode of operation of the improved centerless grinder and it will be seen that it is self-contained for producing all types of work, namely, straight, shouldered or tapered work having a surface of revolution. It will further be noted that the grinding is continuously performed thereby producing work pieces of all classes at a continuous rate and as expeditiously as possible.

What is claimed is:

1. In a centerless grinder of the class described the combination of a pair of horizontally disposed superimposed wheels, one of which is a grinding wheel rotated at a high grinding rate of speed while the other is a stationary wheel for supporting the work while being operated upon by the grinding wheel, means for effecting and varying a separation between the opposed operative surfaces of said wheels, a plurality of work actuating members disposed within the space between said wheels for effecting control of the rotation of the work on the stationary wheel during the grinding operation, means for actuating the grinding wheel and work actuating members at differential rates, and means for mounting said work actuating members for independent adjustment with respect to one another and to the work.

2. In a centerless grinder of the class described the combination of a pair of horizontally disposed superimposed wheels, one of which is a grinding wheel rotated at a high grinding rate of speed while the other is a stationary wheel for supporting the work while being operated upon by the grinding wheel, means for effecting and varying a separation between the opposed operative surfaces of said wheels, a plurality of work actuating members disposed within the space between said wheels for effecting and controlling the rotation of the work on the stationary wheel during the grinding operation, means for actuating the grinding wheel and work actuating members at differential rates, means for mounting said work actuating members for independent adjustment with respect to one another and to the work, and a common support for said work actuating members whereby they are simultaneously actuated for simultaneously shifting a plurality of work pieces.

3. In a centerless grinder of the class described the combination of a grinding wheel rotatable in a horizontal plane, an opposed feeding and work rotation control wheel disposed in a horizontal plane, said wheels being spaced from one another a distance to receive between them and produce a work piece of a predetermined size, said friction control wheel having a loading portion to permit insertion of the work between the wheels, a rapid work shifting portion to effect engagement between the work and grinding wheel, a feeding portion to feed the work into the grinding wheel to effect a stock removal therefrom, and a discharge portion to effect a discharge of the work piece from the space between the wheels, positive means for actuating the work through the space between the wheels along the control portion of the work feeding and controlling wheel, releasable means for normally holding the feed and friction control wheel against rotation during the grinding operation, and means for rotating the said feed and friction control wheel upon release thereof.

4. In a centerless grinder of the class described the combination of a grinding wheel rotatable in a horizontal plane, an opposed feeding and work rotation control wheel disposed in a horizontal plane, said wheels being spaced from one another a distance to receive between them and produce a work piece of a predetermined size, said friction control wheel having a loading portion to permit insertion of the work between the wheels, a rapid work shifting portion to effect engagement between the work and grinding wheel, a feeding portion to feed the work into the grinding wheel to effect a stock removal therefrom, and a discharge portion to effect a discharge of the work piece from the space between the wheels, and positive means for actuating the work through the space between the wheels along the control portion of the work feeding and controlling wheel,

said positive work actuating means comprising a turret, a plurality of pusher members adjustably secured to the turret, and means for rotating the turret at a speed less than the speed of the grinding wheel.

5. In a grinding machine of the class described the combination of a substantially circular bed or column having a vertically disposed axis, a quill rotatably mounted therein concentric to the axis of the bed, a spindle rotatably supported by the quill, a grinding wheel secured to the spindle, a stationary wheel disposed parallel with the grinding wheel but spaced therefrom to provide a grinding throat between said wheels through which the work is shifted, means for adjusting the position of the quill along the axis of the bed or column to vary the width of the grinding throat between the grinding wheel and stationary wheel to accommodate various sizes of work, and a plurality of positive work actuating means operable about the axes of the bed and spindle for simultaneously shifting a plurality of work pieces through the grinding throat between the opposed wheels to produce ground work pieces in a continuous stream.

6. In a grinding machine of the class described the combination with a pair of opposed ring like wheels horizontally disposed, of means for effecting and varying a separation of said wheels to provide a work grinding throat between them, positively actuated means including a plurality of pusher members for shifting work pieces through the grinding throat in a circular path as defined by the wheels, means for supporting the pusher members for universal adjustment with respect to the wheels and work whereby the pushers may be disposed in a skewed relation with respect to the work and effect an axial movement of the work radially of the wheels, and means for actuating the work shifting means.

7. In a grinding machine of the class described the combination with a pair of opposed ring like wheels horizontally disposed, of means for effecting and varying a separation of said wheels to provide a work grinding throat between them, positively actuated means including a plurality of pusher members for shifting work pieces through the grinding throat in a circular path as defined by the wheels, means for supporting the pusher members for universal adjustment with respect to the wheels and work whereby the pushers may be disposed in a skewed relation with respect to the work and effect an axial movement of the work radially of the wheels, means for actuating the work shifting means, and means associated with the work shifting means for limiting the axial movement of the work toward the center of the wheels.

8. In a grinding machine of the class described the combination with a pair of opposed ring like wheels horizontally disposed, of means for effecting and varying a separation of said wheels to provide a work grinding throat between them, positively actuated means including a plurality of pusher members for shifting work pieces through the grinding throat in a circular path as defined by the wheels, means for supporting the pusher members for universal adjustment with respect to the wheels and work whereby the pushers may be disposed in a skewed relation with respect to the work and effect an axial movement of the work radially of the wheels, means for actuating the work shifting means, and means for limiting the axial movement of the work away from the center of the wheels.

9. In a grinding machine of the class described the combination of a substantially circular bed having its axis vertically disposed, a quill carried by the bed having its axis co-incidental with the axis of the bed for adjustment substantially along the axis of the bed, a spindle rotatably mounted in the quill concentric therewith, a grinding wheel secured to the upper end of the spindle and disposed in a horizontal plane, an opposed work rotation friction control wheel supported by the bed and disposed in a horizontal plane, said grinding and friction controlled wheels being spaced from one another to form between them a grinding throat, and means for vertically adjusting the quill and grinding wheel to vary the size of the grinding throat between the wheels.

10. In a grinding machine of the class described the combination of a substantially circular bed having its axis vertically disposed, a quill carried by the bed having its axis co-incidental with the axis of the bed for adjustment substantially along the axis of the bed, a spindle rotatably mounted in the quill concentric therewith, a grinding wheel secured to the upper end of the spindle and disposed in a horizontal plane, an opposed work rotation friction control wheel supported by the bed and disposed in a horizontal plane, said grinding and friction controlled wheels being spaced from one another to form between them a grinding throat, means for vertically adjusting the quill and grinding wheel to vary the size of the grinding throat between the wheels, and pusher means rotatable about the axis of the spindle for actuating work pieces through the grinding throat.

11. In a grinding machine of the class described the combination of a substantially circular bed having its axis vertically disposed, a quill carried by the bed having its axis co-incidental with the axis of the bed for adjustment substantially along the axis of the bed, a spindle rotatably mounted in the quill concentric therewith, a grinding wheel secured to the upper end of the spindle and disposed in a horizontal plane, an opposed work rotation friction control wheel supported by the bed and disposed in a horizontal plane, said grinding and friction controlled wheels being spaced from one another to form between them a grinding throat, means for vertically adjusting the quill and grinding wheel to vary the size of the grinding throat between the wheels, pusher means rotatable about the axis of the spindle for actuating work pieces through the grinding throat, and means for actuating the grinding wheel and work pusher means at differential speeds.

12. In a grinding machine of the class described the combination with a pair of overlying horizontally disposed wheels spaced from one another to form between them a grinding throat, of positively actuated means for shifting work pieces through the grinding throat comprising a turret, a plurality of brackets secured to the turret, a pair of blades carried by each bracket, one on each side of the work for backing same up against the grinding thrust and for effecting an axial shifting of the work, and an end stop between said blades for limiting said axial movement of the work while being operated upon.

13. In a grinding machine of the class described the combination with a pair of superimposed horizontally disposed grinding and work rotation controlling wheels, said wheels having

substantially co-incidental axes about which one of said wheels is normally rotated at a grinding rate of speed, while the other is maintained stationary, of means for shifting one of said wheels along its axis to effect and vary a grinding throat between the wheels, a work actuating mechanism rotatable about the axes of said wheels for simultaneously shifting a plurality of work pieces through the grinding throat, including a rotatable turret, a bracket for each work piece secured to the turret, a blade adjustably mounted on each bracket to dispose same in skewed relation to the axis of the work and thereby tend to axially shift the work while being operated upon, and an end stop carried by each bracket to limit the movement of the work toward the axes of the wheels and the work actuating mechanism.

14. In a grinding machine of the class described the combination with a pair of superimposed horizontally disposed grinding and work rotation controlling wheels, said wheels having substantially co-incidental axes about which one of said wheels is normally rotated at a grinding rate of speed, while the other is maintained stationary, of means for shifting one of said wheels along its axis to effect and vary a grinding throat between the wheels, a work actuating mechanism rotatable about the axes of said wheels for simultaneously shifting a plurality of work pieces through the grinding throat, including a rotatable turret, a bracket for each work piece secured to the turret, a blade adjustably mounted on each bracket to dispose same in skewed relation to the axis of the work and thereby tend to axially shift the work while being operated upon, an end stop carried by each bracket to limit the movement of the work toward the axes of the wheels and the work actuating mechanism, and additional means for limiting the axial movement of the work away from the axes of the wheels and work actuating mechanism.

15. In a grinding machine of the class described the combination with a pair of superimposed horizontally disposed grinding and work rotation controlling wheels, said wheels having substantially co-incidental axes about which one of said wheels is normally rotated at a grinding rate of speed, while the other is maintained stationary, of means for shifting one of said wheels along its axis to effect and vary a grinding throat between the wheels, a work actuating mechanism rotatable about the axes of said wheels for simultaneously shifting a plurality of work pieces through the grinding throat, including a rotatable turret, a bracket for each work piece secured to the turret, a blade adjustably mounted on each bracket to dispose same in skewed relation to the axis of the work and thereby tend to axially shift the work while being operated upon, an end stop carried by each bracket to limit the movement of the work toward the axes of the wheels and the work actuating mechanism, means for rotating the grinding wheel at a grinding rate of speed, and independent means for rotating the work actuating turret at a relatively slow work feeding rate of speed.

16. In a grinding machine of the class described the combination with a pair of superimposed horizontally disposed grinding and work rotation controlling wheels, said wheels having substantially co-incidental axes about which one of said wheels is normally rotated at a grinding rate of speed, while the other is maintained stationary, of means for shifting one of said wheels along its axis to effect and vary a grinding throat between the wheels, a work actuating mechanism rotatable about the axes of said wheels for simultaneously shifting a plurality of work pieces through the grinding throat, including a rotatable turret, a bracket for each work piece secured to the turret, a blade adjustably mounted on each bracket to dispose same in skewed relation to the axis of the work and thereby tend to axially shift the work while being operated upon, an end stop carried by each bracket to limit the movement of the work toward the axes of the wheels and the work actuating mechanism, means for rotating the grinding wheel at a grinding rate of speed, independent means for rotating the work actuating turret at a relatively slow work feeding rate of speed, and additional independent means for rotating the normally stationary friction control wheel when not in operative engagement with work pieces.

BENJAMIN R. PURVIN.