

July 28, 1931.

C. BOOTH

1,816,170

GRINDING MACHINERY

Filed Feb. 1, 1929

4 Sheets-Sheet 1

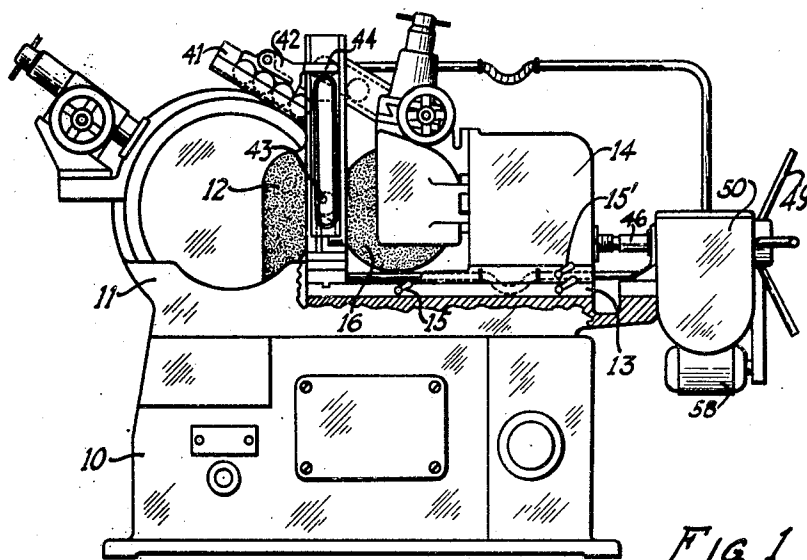
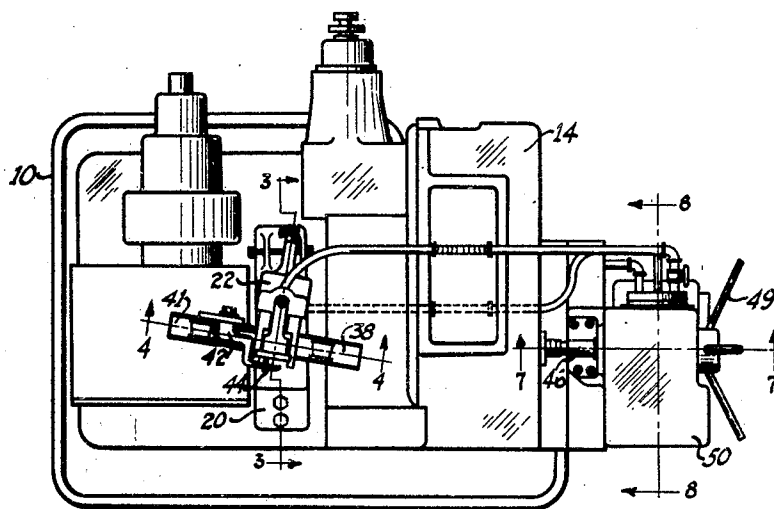


FIG. 2

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4 Sheets-Sheet 2

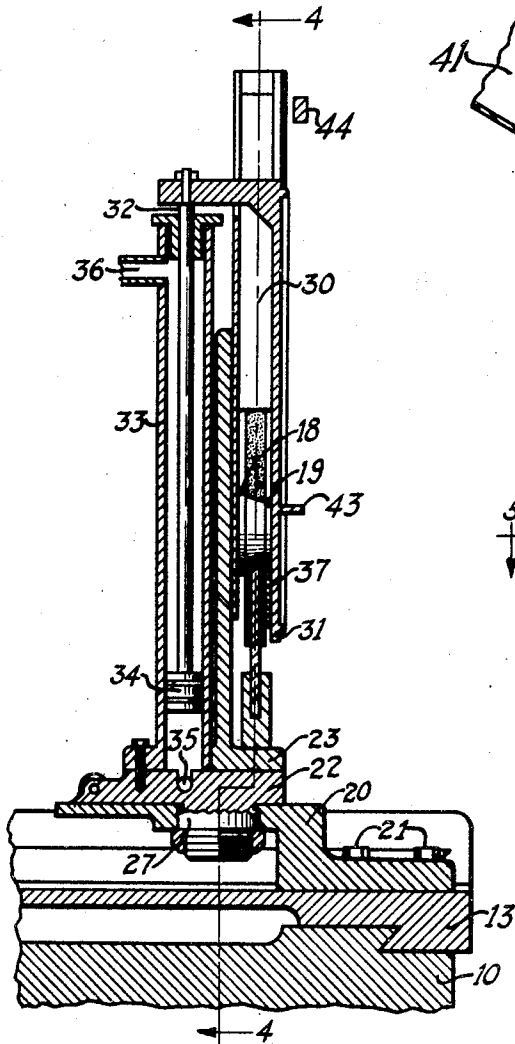


FIG. 3

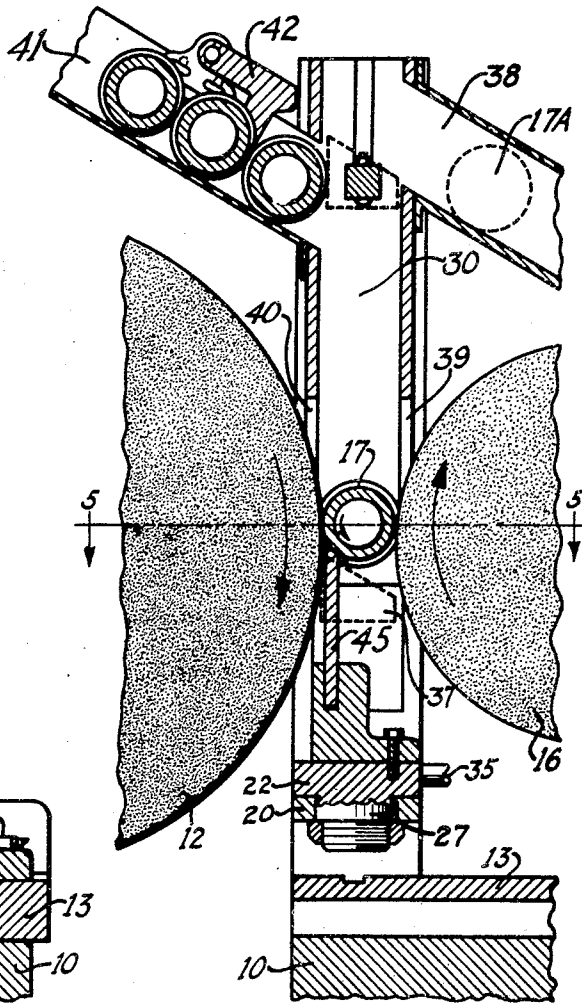


FIG. 4

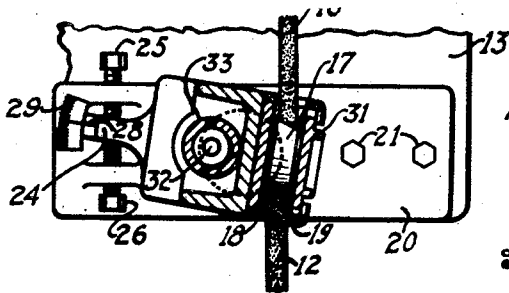


FIG. 5

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4 Sheets-Sheet 3

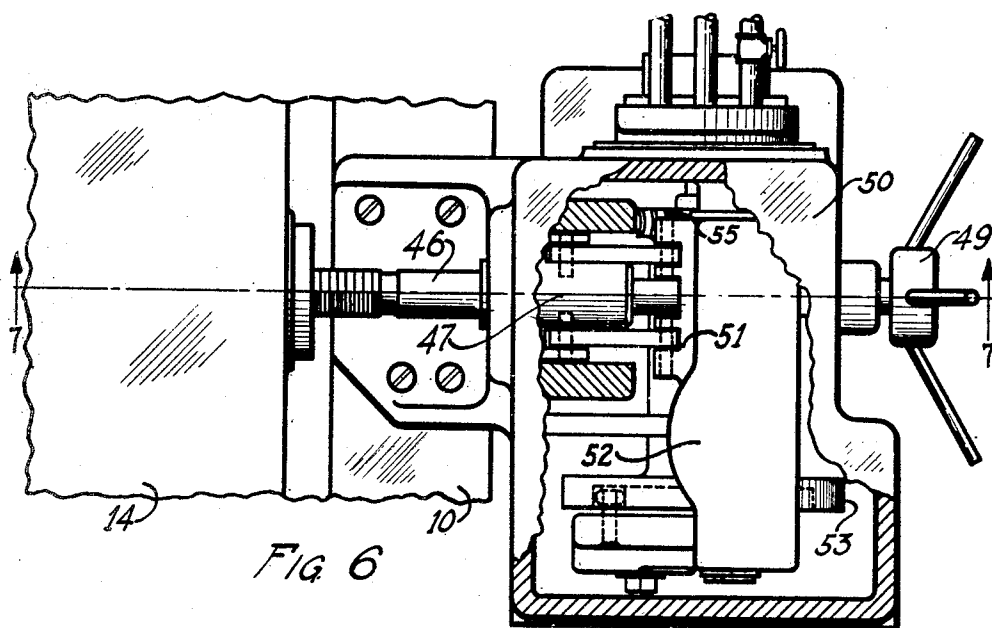


FIG 6

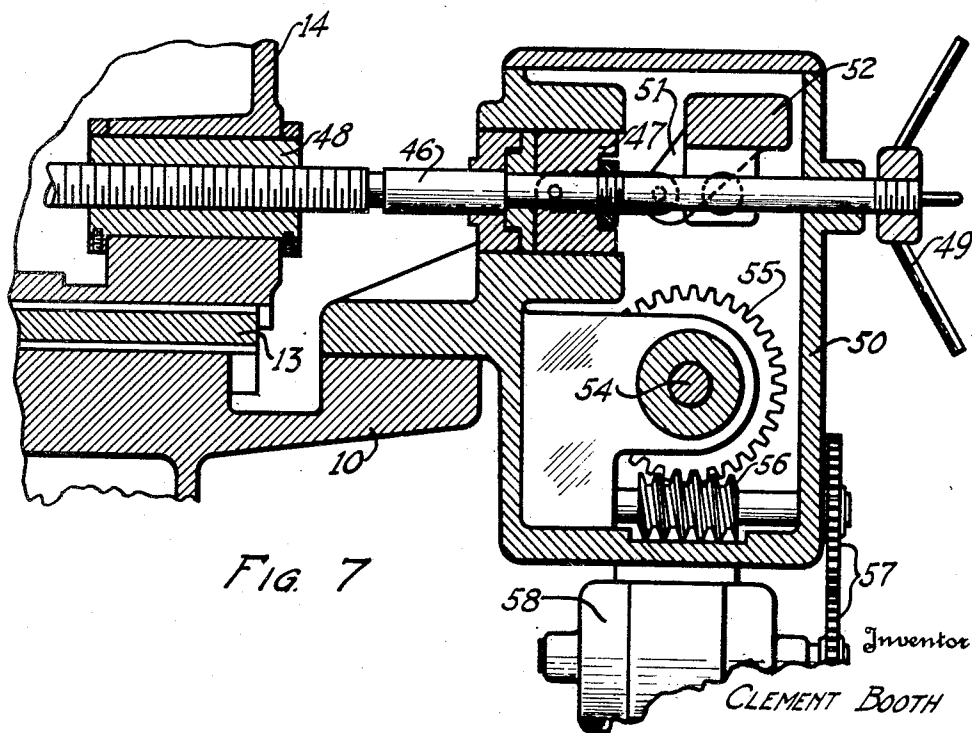


FIG 7

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384

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4 Sheets-Sheet 4

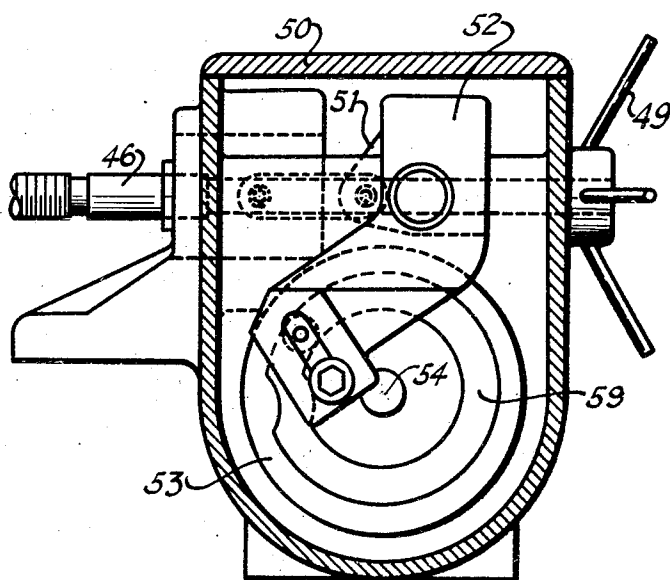


FIG. 9

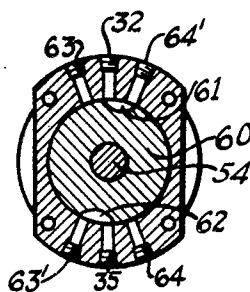


FIG. 10

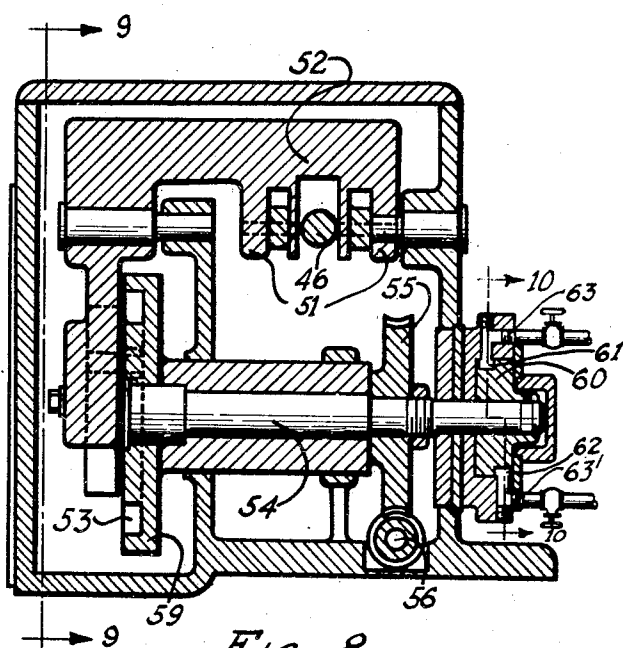


FIG 8

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UNITED STATES PATENT OFFICE

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GRINDING MACHINERY

Application filed February 1, 1929. Serial No. 336,800.

This invention relates to improvements in grinding machinery and has particular reference to machinery for the production of contoured or like articles having other than a plain cylindrical surface or surface of revolution of uniform diameter.

One of the objects of the present invention is the provision of a machine which may be readily utilized for the grinding of a selected portion only of a work piece surface in which the contour of the article as an entirety is such as to render impractical, axial feeding thereof past the grinding wheel.

A further object of the present invention is the provision of a novel mechanism capable of automatic or other control for facilitating introduction and removal of work pieces from a centerless grinder.

An additional object of the invention is the provision of an improved work supporting and controlling mechanism which will facilitate the production of frustro-conical or like shaped work pieces in a centerless grinder and will satisfactorily restrain axial movement of the work piece during said grinding.

A further object of the invention is the provision of an improved automatic mechanism for controlling the introduction, maintenance in grinding position and ejection of work pieces in connection with the performance of an in-feed centerless grinding operation thereon.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in connection with the accompanying drawings, illustrative of one embodiment thereof, and it will be understood that I may make any modifications in the specific structural details in the arrangement of parts hereinafter described within the scope of the appended claims without departing from and exceeding the spirit of the invention.

Figure 1 is a front view of a machine embodying the improvements in question.

Figure 2 is a top plan view thereof.

Figure 3 is a vertical sectional view as on line 3—3 of Figure 2.

Figure 4 is a vertical section at right angles to Figure 3 taken as on the line 4—4 of Figures 2 and 3.

Figure 5 is a fragmentary, horizontal, sectional view through the work guiding and maintaining members showing the engagement of the grinding and regulating wheels therewith as on line 5—5 of Figure 4.

Figure 6 is a view partially in plan and partially in section of the regulating wheel slide controlling mechanism.

Figure 7 is a vertical section therethrough as on the line 7—7 of Figures 2 and 6.

Figure 8 is a vertical plan at right angles to Figure 7 as on the line 8—8 of Figures 2 and 7.

Figure 9 is a sectional view on line 9—9 of Figure 8, and

Figure 10 is a section through the work position controlling valve, taken as on line 10—10 of Figure 8.

In the drawings, the numeral 10 designates the bed of a centerless grinder having rising therefrom the head 11 supporting the grinding wheel 12. Mounted on the bed 10 is a main slide 13 bearing a supplemental slide 14 movable therewith and relative thereto. Slide 13 may be clamped in position on the bed as by the clamp 15 while slide 14 is secured in position on intermediate slide 13 by the clamps 15'.

Slide 13 serves as a support for the work supporting, feeding and ejecting mechanism as hereinafter described in detail.

Slide 14 bears the regulating wheel 16 which may be of abrasive material to best secure an accurate position on the work or in some instances may be formed from cast iron or other material having a suitable friction surface for engagement with the work to control the rate of rotation thereof.

By reference to Figure 5 it will be noted that the grinding wheel 12 has a plane or cylindrical periphery while the regulating wheel 16 is formed with an inclined or bevelled face which is double that of the taper to be produced on the work in this particular instance. The work here shown com-

prises a cone or race 17 such as is employed in connection with roller bearings having a central race way as at 17 and the terminal flanges 18 and 19. This race-way must be ground with extreme accuracy and in definite relation to the face of the base flange 18 thereof. Its form renders it difficult to axially introduce and remove the work piece from a centerless grinder and at the same time renders it impossible to axially feed the work piece through the machine during grinding.

The fixture for automatic control of the position of the work during grinding as well as its introduction into grinding position and removal therefrom includes a base bracket 20 secured to slide 13 as by bolts 21. This bracket has swiveled thereon base 22 of the up-right or column 23 and is provided with the lateral extension 24 projecting between lock screws 25 and 26 which serves to secure the base in desired uniformly adjusted position about its trunnion 27. A graduation 28 cooperating with scale 29 on bracket 20 facilitates the desired angular positioning thereof.

Column 20 has suitably secured thereto a substantially rectangular guide chute 30 of size to suitably receive the work pieces to be ground and the guiding slide 31 for shifting said work pieces. This slide is vertically movable through the chute as by a piston rod 32 coupled therewith, and moving within the cylinder 33 on the bracket. The rod bears a piston 34 for actuation of the slide, serving to raise the slide when air or other pressure is introduced through conduit 35 at the bottom of the cylinder and to force the piston and slide downward when suitable actuating pressure is introduced through conduit 36 at the upper end of the cylinder.

The slide is inwardly provided with a work supporting plate 37 for engagement with the work piece flange 19, said plate supporting the work during its vertical movement in the chute and being inclined in the direction of the regulating wheel whereby the weight of the work will cause the same, under influence of gravity, to roll off the supporting plate into the discharge chute 38 when the parts are in raised position as indicated by the dotted lines on Figure 4 and will similarly allow the work to move by gravity toward the regulating wheel 16 as the work is carried downward in the chute by feeding movement of the slide.

It will be noted that the chute is provided with the lateral slots 39 and 40 permitting the regulating and grinding wheels respectively, to project therein and engage the work as is shown in Figure 5.

In operation, a plurality of work pieces are placed in the feed chute or hopper 41, being held against inward movement as by

the spring pressed detent 42 as slide 31 is moved upward lug 43 thereon contacts with control arm or projection 44 on the detent raising the detent so that a work piece may roll forward into lateral engagement with plate 37 moving upward there-beyond to the top limit of its stroke. As the plate is depressed the detent will drop down back of the succeeding work piece in the loading chute. The continued movement of the plate allows the work piece to roll into the confines of the said chute 30 in which the work will be carried with the plate until in grinding position between the wheels.

For the support of the work in this position use is preferably made of a suitable angle top work rest blade 45. This may be a part of either the work carrying slide or an attachment on the stationary bracket 22 and in the form illustrated it is shown as rigidly mounted on bracket 22 and in the path of downward movement of the surface 17 of the work. Consequently, the plate will move into position, releasing the work or allowing the surface thereof to be ground to rest upon and be supported by blade 45. When in this position the angle of adjustment of chute 30 and the angle of bevel of regulating wheel 16 is such that the work at the grinding point is presented, preferably as shown, with its axis in inclined relation to the grinding wheel corresponding to the taper to be produced and the actual surface square or parallel with the operative face of the grinding wheel. This relative location of parts makes it possible to true and maintain a plane, cylindrical surface on the grinding wheel reducing the unsupported, sharp corner effect of the grinding wheel with its liability to rapid wear and in its place substituting the plain surface in which both surface and corners will best stand up under continuous production grinding. In this position the taper on the work and regulating wheel will force flange 18 to peripherally seat itself against the end wall of chute 30 which thus serves as a locked medium preventing tilting or lateral deflection or displacement of the work.

That the desired stock may be best removed and the work ground to the desired prescribed diameter it is preferable that the work be introduced between the wheels and the separation of the wheels thus varied to first grip and grind the work and subsequently release the work prior to withdrawal thereof from operative position within the machine. It will be understood however, that due to the manner of feeding the work the feeding action can if desired be of such nature that the grinding will start as the work is introduced between the wheels and the limit of grinding reached when the work is at lowermost position.

However, when it is desired to use the

in-feed method of grinding in which the separation of the wheels is varied, a mechanism such as particularly illustrated in Figures 6 to 9 inclusive of the drawings, may be utilized. This mechanism comprises an elongated adjusting screw 46 swiveled in slide block 47 and having threaded engagement with the rotatable bushing 48 carried by the regulating wheel slide member 14. Rotation of the screw for adjustment of the position of slide 14 with respect to block 47 is effected through pilot wheel 49 while the oscillation of threaded bushing 48 will cause a relative shifting of the slide back and forth with respect to the fixed position of slide block 47. Slide block 47 is mounted in bracket 50 carried by the bed 10 and has actuable linkage 51, toggle arm 52 and actuating cam 53 on shaft 54. This shaft bears a worm gear 55 in mesh with worm 56 driven through gear 57 from motor 58. The mechanism here in question, being of the nature described and claimed in detail in co-pending application 102,762, filed April 12th, 1926. It will be understood that the path 59 of cam 53 is such as to oscillate toggle 52 for each rotation of the shaft and thus from the linkage to impart a prescribed back and forth sliding movement to block 47 and thus to the regulating wheel slide 14 causing successive approach and receding movement of the regulating wheel with respect to the grinding wheel.

Shaft 54 projects rearwardly of the shifting mechanism housing or bracket 50 and bears the rotary valve 60 having the offset chambers 61 and 62 and these are diametrically, oppositely arranged in such manner that at the given point in rotation of shaft 54, the grinding and regulating wheels are separated substantially a maximum amount, the chamber 60 will first couple conduit 32 from the upper end of the cylinder with the exhaust port 63. At the same time conduit 35 from the lower end of the cylinder will be coupled with the pressure line 64 introducing pressure at the lower end of the cylinder 33 to raise piston 34 and thus the slide and appended parts to a height indicated by the dotted line in Figure 4 when the completed work piece shown at 17A will roll off inclined supporting plate 37 into discharge chute 38.

Continued rotation of shaft 54 and thus of valve member 60 will then couple conduit 35 with exhaust port 63' and conduit 32 with pressure in that port 64' with the piston will be urged in a reverse direction and will carry the fresh work piece downward into operative position between the wheels, the successive work piece being then presented into grinding position shown in Figure 4 and the parts will remain at rest in this position with all pressure cut off due to continued rotation of the valve. At the

same time, the continued rotation of the cam will move the regulating wheel inward in a progressive manner until the work piece has been gradually reduced to size.

This inward pressure of the regulating wheel due to its bevelled shape in addition to urging the work against the grinding wheel, will also urge the work axially into formal engagement with the left hand wall of the chute to the extent that the axial position of the work will be positively determined by the inter-engagement of the base flange of the work with the wall of the chute and the same peripherally steadied and held in position while controlled in rotation by the regulating wheel. It is to be understood that for purposes of grinding the wheel 12 is rotated at a high grinding rate of speed in the direction of the work supporting rest 45 as indicated by the arrow in Figure 4 while the regulating wheel is rotated at a slower rate of speed in the direction of the arrow in said figure to control position and rate of rotation of the work.

From the foregoing description the operation of the present mechanism should be readily understood and it will be seen that with the grinding and regulating wheels peripherally driven and work pieces placed in the hopper upon actuation of motor 58 the control chute 54 will be driven at a slow rate of speed and rotation of the shaft automatically operating valve 60 causing a retraction of the feed slide gathering a fresh work piece at the inception of its downward stroke and carrying the work into position within the grinding throat.

Continued rotation of control shaft 54 thus through its cam 53 causes the proper narrowing of the grinding throat for most efficient stock removal, the subsequent retraction of the regulating wheel pinion to the grinding throat and releasing the work when the next stroke of piston 34 as controlled by valve 60 will move the slide and completed work piece to an uppermost position as shown when the completed work piece is discharged into chute 38 and the entire operation automatically repeated.

It will be noted that the axis of rotation of the work and that of the regulating wheel are disposed at an angle one to the other, with the result that a feed thrust component is exerted holding the work against the stop plate. This function will be effected irrespective of the particular shape of the work and regulating wheels provided the paths of travel of their contacting surfaces are in angular relationship one to the other producing the desired axial thrust component or urge against the work.

I claim:

1. A grinding machine of the centerless type including a grinding wheel operable at

- a high grinding rate of speed, an opposed regulating wheel operable at a slow work controlling rate of speed, a column member projecting adjacent the throat between said wheels, means carried by the column for restraining axial movement of a work piece in the grinding throat and an additional means carried by the column for radially shifting a work piece relative to said grinding throat.
2. A centerless grinder including a bed, grinding and regulating wheels supported by the bed to provide a work receiving throat there between, a bracket carried by the bed adjacent the throat, a slide on the bracket for controlling vertical movement of a work piece toward and from the grinding throat and an hydraulic control mechanism including a piston and cylinder therefor, one of said parts being fixed with respect to the bed, and the other of said parts being coupled to the slide for actuation thereof.
3. In a machine of the character described comprising a bed, opposed grinding and regulating wheels carried by the bed, in position to provide a work receiving throat therebetween, a bracket carried by the bed, a work controlling mechanism pivoted to the bracket for angular adjustment relative to the bed, said mechanism including a work receiving chute having a portion for terminally engaging the work piece to restrain its axial movement and means movable longitudinally of the chute for controlling the position of a work piece with respect to the grinding throat.
4. A centerless grinder including opposed grinding and regulating wheels forming a work receiving throat therebetween, means for introducing and removing a work piece in a tangential direction as respects said throat including a chute having a work delivery portion adjacent the throat and a work discharge portion more distant therefrom, a slide member having a work engaging portion movable from a position within the grinding throat to a position aligning the work with the discharge branch of the chute and means for automatically controlling the delivery of individual work pieces to said member on the slide.
5. A centerless grinder including opposed grinding and regulating wheels, a work rest projecting into the throat between said wheels for supporting a work piece during grinding and means for controlling the position of the axis of the work with respect to the grinding wheel including an angularly adjustable bracket having a bearing surface for terminal engagement with the work piece.
6. A centerless grinder including opposed grinding and regulating wheels, a work rest projecting into the throat between said wheels for supporting a work piece during grinding, means for controlling the position of the axis of the work with respect to the grinding wheel including an angularly adjustable bracket having a bearing surface for terminal engagement with the work piece, a slide carried by the bracket, a work engaging member on the slide and means for actuating the slide to raise and lower a work piece as respects the grinding throat.
7. A centerless grinder including opposed grinding and regulating wheels, a work rest projecting into the throat between said wheels for supporting a work piece during grinding, means for controlling the position of the axis of the work with respect to the grinding wheel including an angularly adjustable bracket having a bearing surface for terminal engagement with the work piece, a slide carried by the bracket, a work engaging member on the slide, means for actuating the slide to raise and lower a work piece as respects the grinding throat, and a discharge chute off-set as respects the operative surface of the work rest for receiving completed work pieces when they are laterally withdrawn by the slide.
8. A centerless grinder including opposed grinding and regulating wheels, a work rest projecting into the throat between said wheels for supporting a work piece during grinding, means for controlling the position of the axis of the work with respect to the grinding wheel including an angularly adjustable bracket having a bearing surface for terminal engagement with the work piece, a slide carried by the bracket, a work engaging member on the slide, means for actuating the slide to raise and lower a work piece as respects the grinding throat, a discharge chute for receiving completed work pieces when they are laterally withdrawn by the slide, a feed chute, and means automatically operable on reciprocation of the slide for discharging a work piece on to the work controlling member of the slide subsequent to the ejection of the completed work piece.
9. A machine of the character described, including opposed grinding and regulating wheels adapted to receive a work piece therebetween, one of said wheels being movable toward and from the other to vary the width of grinding throat, hydraulically actuatable means for controlling the lateral insertion and removal of a work piece from the grinding throat, and means for automatically effecting the relative movement of the wheels and the actuation of the hydraulic mechanism for insertion and removal of a work piece in predetermined timed relation.
10. A machine of the character described, including opposed grinding and regulating wheels adapted to receive a work piece therebetween, one of said wheels being movable toward and from the other to vary the width of grinding throat, hydraulically actuatable

means for controlling the lateral insertion and removal of a work piece from the grinding throat, means for automatically effecting the relative movement of the wheels and the actuation of the hydraulic mechanism for insertion and removal of a work piece in predetermined, timed relation, said means including a rotatable shaft, a wheel movement controlling cam actuated by the shaft, an hydraulic valve coupled with the shaft for actuation in prescribed relation to the movement of the cam.

11. A machine for the centerless grinding of the periphery of a ring or other narrow article including opposed grinding and regulating wheels spaced to provide a work receiving throat therebetween, a work rest projecting into the throat for peripheral engagement with a work piece, positioning members projecting adjacent the work rest for engagement with the termini of the work piece during grinding to position the same between the wheels and prevent tilting thereof.

12. A machine for the centerless grinding of the periphery of a ring or other narrow article including opposed grinding and regulating wheels spaced to provide a work receiving throat therebetween, a work rest projecting into the throat for peripheral engagement with a work piece, positioning members projecting adjacent the work rest for engagement with the termini of the work piece to position the same between the wheels and prevent tilting thereof, said terminal engaging means being supported for angular adjustment whereby the relationship of the axis of the work to the grinding wheel may be varied for the production of frustro-conical or like work pieces.

13. A machine for the centerless grinding of the periphery of a ring or other narrow article including opposed grinding and regulating wheels spaced to provide a work receiving throat therebetween, a work rest projecting into the throat for peripheral engagement with a work piece, positioning members projecting adjacent the work rest for engagement with the termini of the work piece to position the same between the wheels and prevent tilting thereof, said terminal engaging means being supported for angular adjustment whereby the relationship of the axis of the work to the grinding wheel may be varied for the production of frustro-conical or like work pieces, a slide for controlling the introduction and removal of work from the grinding throat, said slide having a work engaging portion inclined in the direction of the regulating wheel whereby initial contact will be produced between the work and regulating wheel during the introduction into the grinding throat.

14. A machine for the centerless grinding of the periphery of a ring or other nar-

row article including opposed grinding and regulating wheels spaced to provide a work receiving throat therebetween, a work rest projecting into the throat for peripheral engagement with a work piece, positioning members projecting adjacent the work rest for engagement with the termini of the work piece to position the same between the wheels and prevent tilting thereof, said terminal engaging means being supported for angular adjustment whereby the relationship of the axis of the work to the grinding wheel may be varied for the production of frustro-conical or like work pieces, a slide for controlling the introduction and removal of work from the grinding throat, said slide having a work engaging portion inclined in the direction of the regulating wheel whereby initial contact will be produced between the work and regulating wheel during the introduction into the grinding throat, and a discharge chute adjacent the regulating wheel whereby the angle of the work engaging member will be toward the chute urging discharge or the work withdrawn into alignment therewith.

15. The combination with a centerless grinder including the opposed grinding and regulating wheels providing a work receiving throat therebetween, of an automatic feed and ejection mechanism for said machine including a work guiding chute extending adjacent the grinding throat between the wheels, a work in-feed chute branching therefrom, a work discharge chute branch therefrom at a point more remote than the in-feed chute, both of said chutes being inclined in a common direction whereby gravity will feed the work from one to the other, and means for controlling the several movements of the work including a slide, an angle top plate carried by the slide, means for reciprocating the slide between a working position adjacent the grinding throat and a discharge position adjacent the discharge chute, a trip controlled means for normally restraining the movement of work pieces in the feed chute, the slide having a trip for releasing an individual work piece and the preceding work piece is moved into discharge position and having a portion temporarily restraining movement of the released work piece in the feed chute prior to the sub-tending of the feed chute by the angle top work controlling plate.

16. A centerless grinder including a bed, grinding and regulating wheels supported thereby for relative movement, means for relatively moving the wheels to control the amount of grinding individually performed on successive work pieces, hydraulically operated means for presenting and withdrawing work pieces from operative position between the wheels, a synchronizing mecha-

nism coupling the wheel and work controlling members whereby a completed work piece is ejected and a fresh work piece automatically inserted during the separation of the grinding and regulating wheels.

17. A machine of the character described including opposed grinding and regulating wheels forming a work receiving throat there-between, an angularly adjustable work positioning member disposed adjacent the grinding throat, means for determining the angular relationship between the grinding wheel and work support to vary the surface of revolution generated by the grinding wheel on a work piece engaged by the support and means for automatically successively presenting a series of work pieces to the grinding throat in the same predetermined angular relationship to the grinding wheel.

18. A machine of the character described including opposed grinding and regulating wheels forming a work receiving throat there-between, an angularly adjustable work positioning member disposed adjacent the grinding throat, means for determining the angular relationship between the grinding wheel and work support to vary the surface of revolution generated by the grinding wheel on a work piece engaged by the support and means for automatically successively presenting a series of work pieces to the grinding throat in the same predetermined angular relationship to the grinding wheel, and means for automatically effecting a relative movement of the grinding and regulating wheels as each successive work piece is presented therebetween, whereby successive work pieces are individually ground to prescribed size.

19. In a grinding machine of the character described the combination of a bed, a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, one of said wheels being movable relative to the bed toward and from the other wheel, a work support within the throat, means for placing on and removing a work piece from the work support including a shiftable member, means for actuating one of the wheels toward the other including a driven shaft and a cam operated by the driven shaft, an hydraulic circuit for actuating the shiftable member, and means controlling the flow of the hydraulic medium through the circuit coupled with the driven shaft whereby the actuation of the wheel and the actuation of the shiftable member are in timed sequential order.

20. In a machine of the character described, the combination of a bed, a pair of opposed grinding and regulating wheels carried thereby and forming a grinding throat therebetween, means for advancing and retracting one of the wheels toward and from the other, means for controlling the

introduction and removal of a work piece from the grinding throat including a feed slide movable radially of the grinding throat, hydraulic means for controlling the movement of the feed slide, and an operative coupling between the means for advancing and retracting the wheel and the means for controlling the movement of the feed slide whereby a finished work piece is removed and an unfinished one placed in the grinding throat when the wheels are in a retracted position.

21. In a machine of the character described the combination of a bed, a pair of opposed grinding and regulating wheels carried thereby and forming a grinding throat therebetween, and means for placing in and removing a work piece from the grinding throat comprising a guide bracket, feed slide movable relative to the guide bracket radially of the grinding throat, an hydraulic medium for effecting the movement of the slide, and a rotating valve controlling the flow of the medium to first move the slide in one direction to place a work piece in the grinding throat and then in the other direction to remove a work piece from the grinding throat.

In testimony whereof I affix my signature.

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