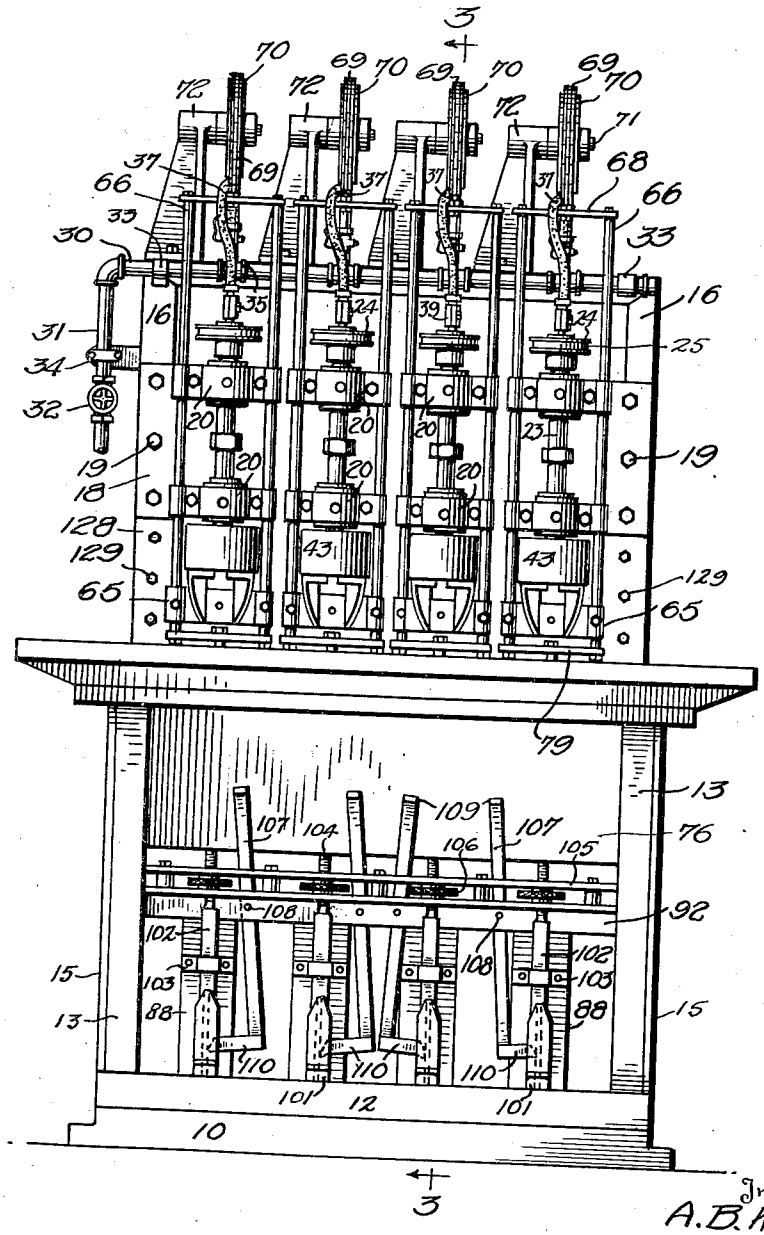
Jan. 2, 1940. A. B. KNIGHT 2,185,344

GRINDING APPARATUS

Filed July 8, 1936. 5 Sheets-Sheet 1

Fig. 1.



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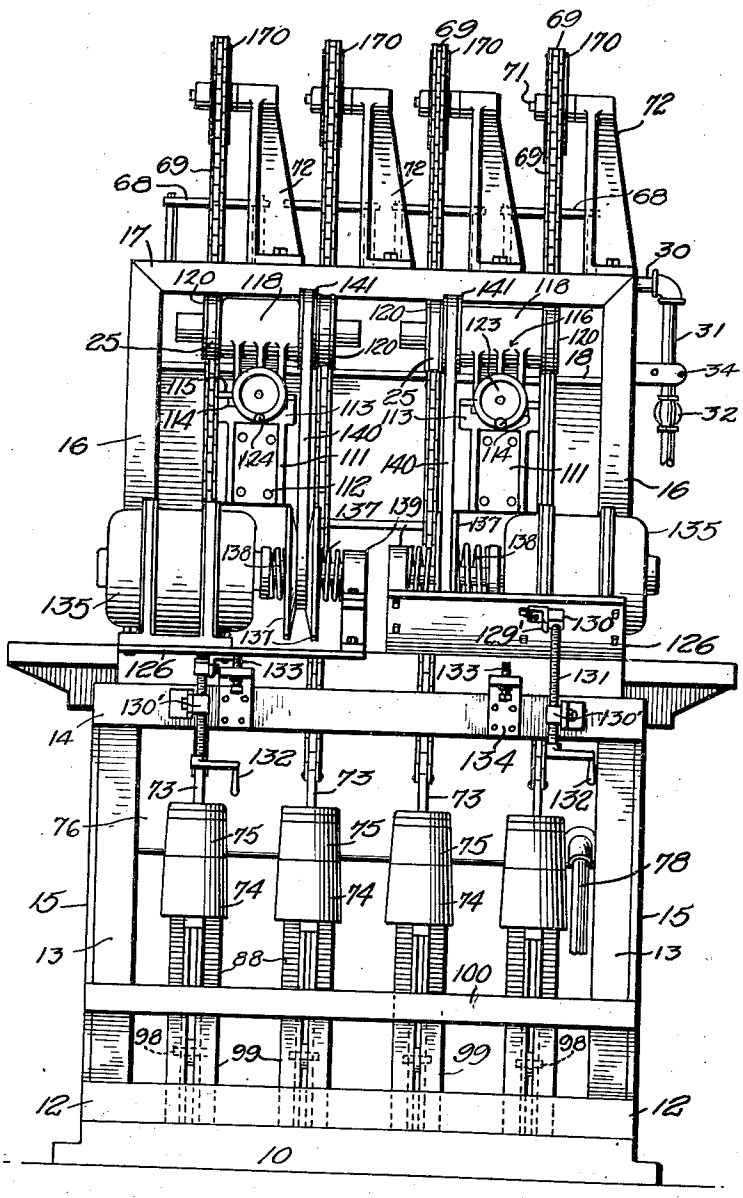
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GRINDING APPARATUS

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Fig. 2.



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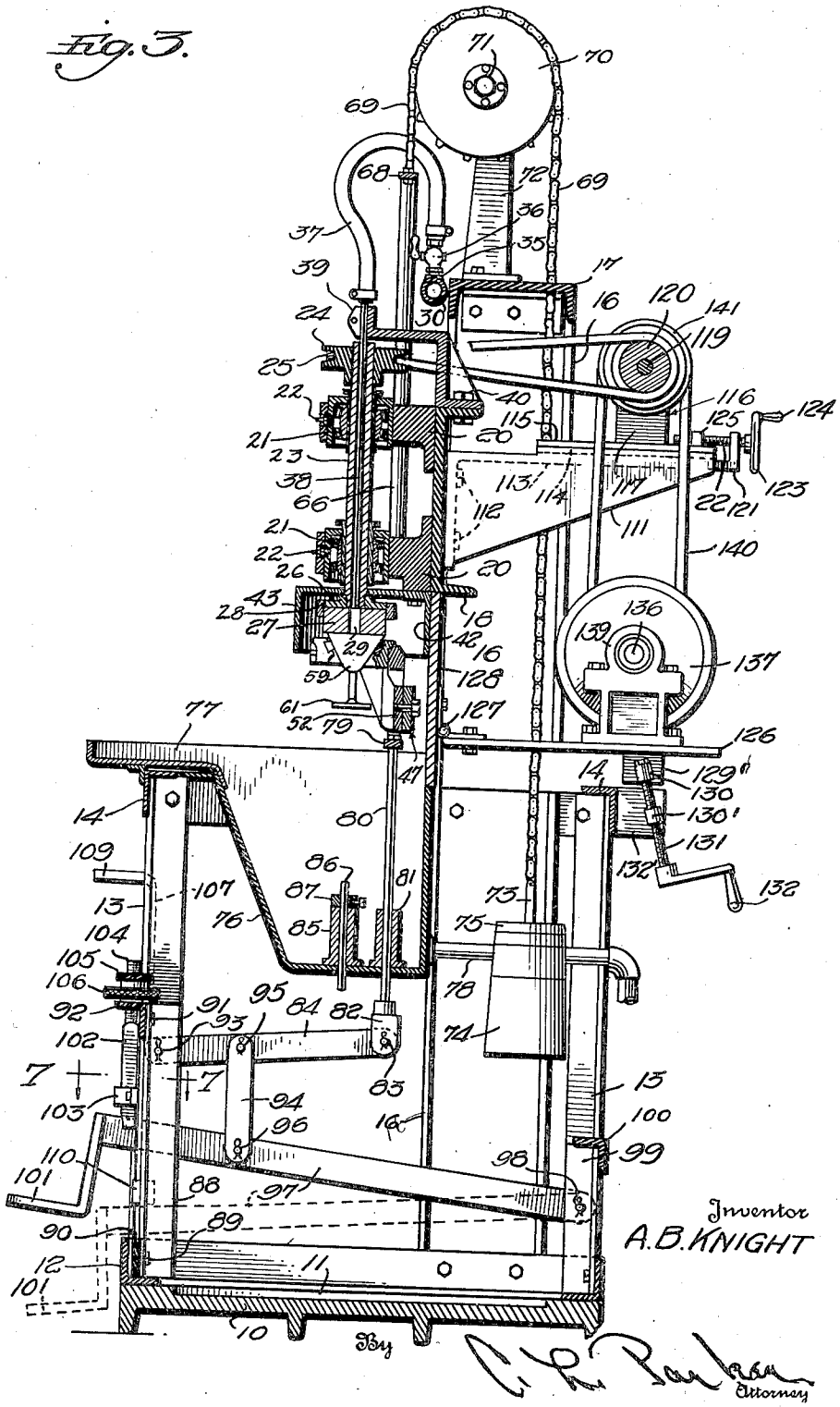
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GRINDING APPARATUS

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Fig. 3.



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GRINDING APPARATUS

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Fig. 4.

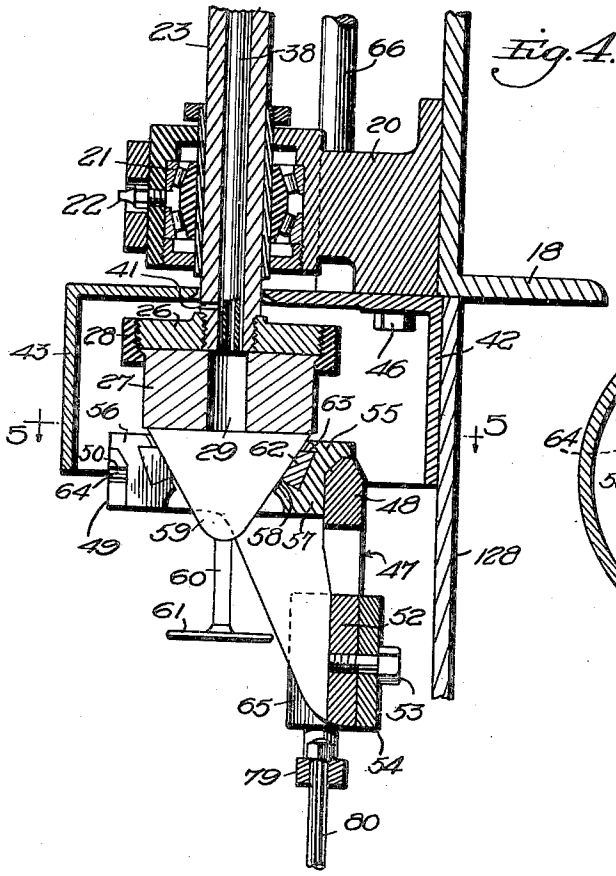


Fig. 5.

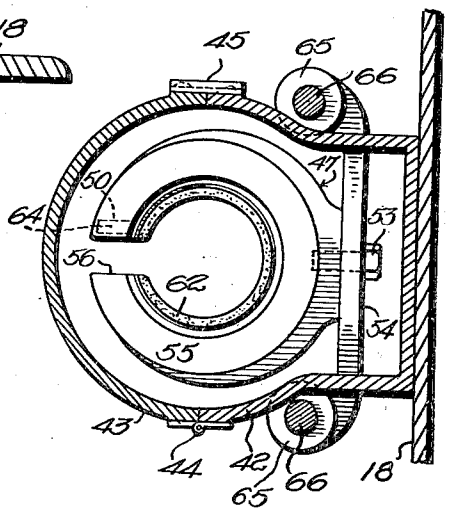


Fig. 7.

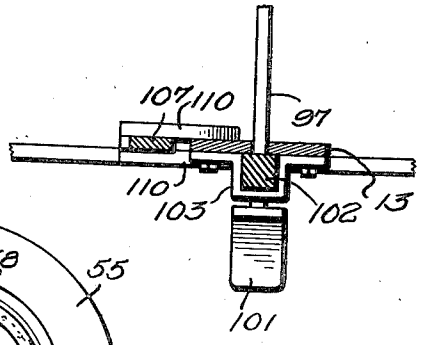
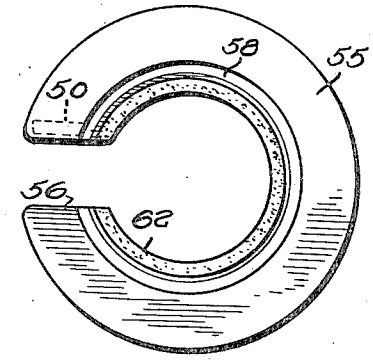


Fig. 6.



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GRINDING APPARATUS

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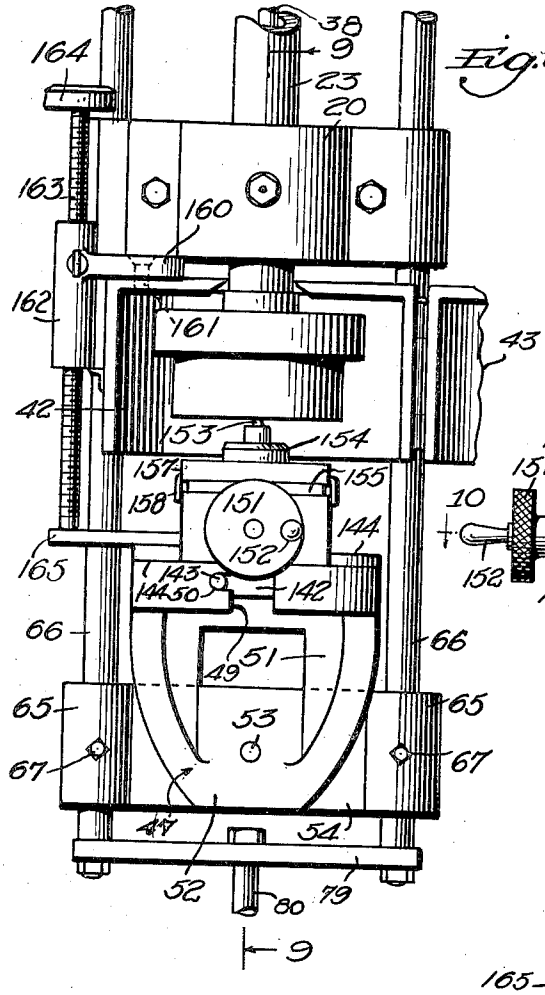


Fig. 8.

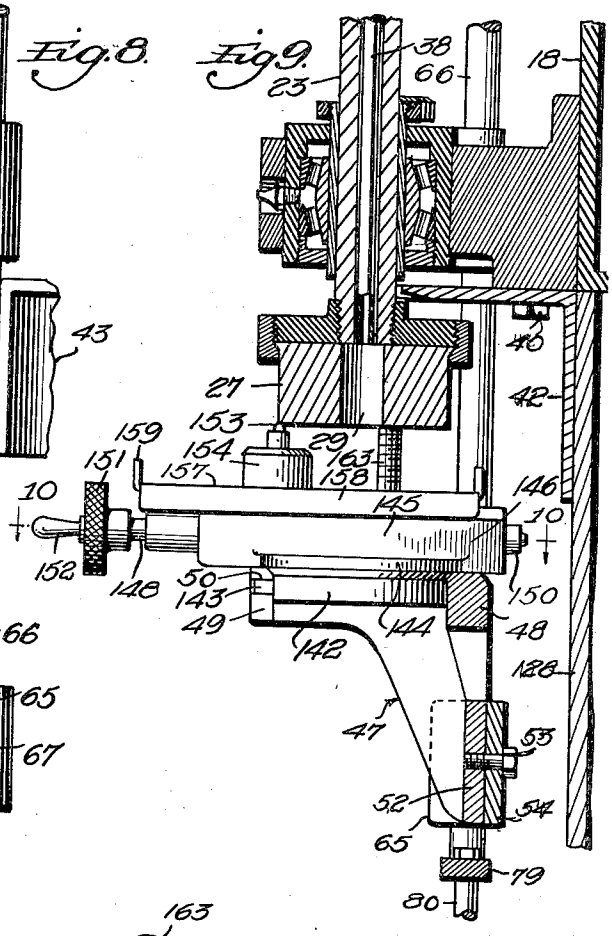


Fig. 9.

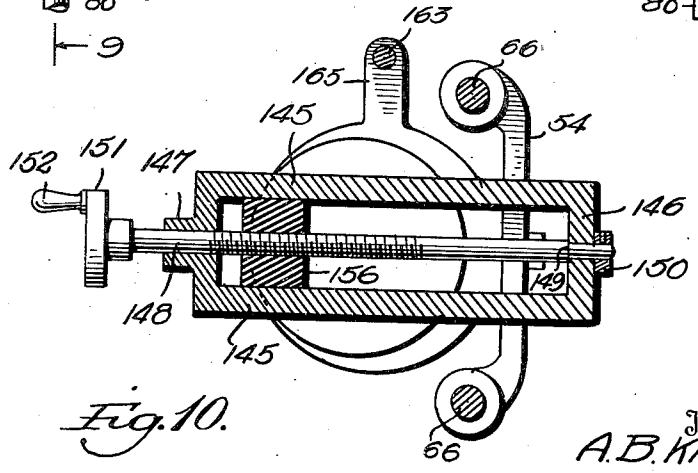


Fig. 10.

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UNITED STATES PATENT OFFICE

2,185,344

GRINDING APPARATUS

Albert Breakenridge Knight, Fairmont, W. Va.

Application July 8, 1936, Serial No. 89,631

13 Claims. (Cl. 51—125)

This invention relates to grinding apparatus, and more particularly to an apparatus for grinding the edges of glassware.

In the manufacture of articles of glass, such as tumblers, sherbets, etc., the glass, after being blown, contains the usual excess glass above what is to be the upper limit of the glass article. The glassware is then subjected to the operation of etching and cracking, which consists in etching a line approximately at what is to be the upper limit of the glassware, and then subjecting the ware to the action of a burner which causes the ware to crack off around the etched line.

The glassware does not crack off perfectly straight, that, is in an exact plane, and accordingly the ware, after being cracked off, is subjected to a grinding action to smooth and level off the upper edge of the ware, after which it is subjected to the action of a glazing burner, which smooths the surface of the ware and softens the upper ground edge thereof to give it a perfectly smooth glazed edge.

The various forms of apparatus which have been employed for grinding glassware in the manner stated have been unsatisfactory for a number of reasons. For example, grinding machines have been developed wherein the grinding action takes place with the glassware supported in a horizontal position. Extreme difficulty has been encountered in properly supporting the ware during the grinding operation, and a substantial amount of breakage occurs through the action of the vibration of the apparatus. This is particularly true in connection with stem ware, in which the stems are frequently broken by vibration. This fault is largely overcome in vertical grinding machines in which the ware is ground by means of a rotating stone disposed therebeneath. However, the ware is not particularly easy to handle in an apparatus of this character and since water must be constantly supplied at the grinding point, the water flows downwardly into the operating parts of the mechanism.

An important object of the present invention is to provide a novel glassware grinding machine wherein the ware is ground in a vertical position and is moved relative to the rotating stone to engage the bottom face thereof.

A further object is to provide an apparatus of the character referred to wherein the point of grinding is arranged wholly below the main operating parts of the apparatus, thus permitting water to be fed freely to the point of grinding without flowing to the operating parts of the apparatus.

A further object is to provide an apparatus of this character having a vertical rotating hollow spindle with a grinding stone at the lower end thereof, and to provide novel means for feeding water to the point of grinding by arranging a water supply pipe in the interior of the spindle.

A further object is to provide novel chuck means for supporting the glassware during the grinding operation.

A further object is to provide a chuck wherein the glass properly centers itself to be ground with its upper edge in a plane at right angles to the axis of the glass.

A further object is to provide novel means for vertically moving the chuck with respect to the grinding stone to facilitate the loading and unloading of the chucks.

A further object is to provide novel counterweight means for determining the pressure at which the glassware is held against the grinding stone during the grinding operation.

A further object is to provide novel driving means for the grinding spindles.

A further object is to provide novel means for retaining the glass holding chucks retracted from the grinding stones.

A further object is to provide a novel chuck holder for the glass supporting chuck, and to provide means adapted to be supported by the chuck holder and operative for smoothing the grinding face of the stone where it becomes rough or grooved.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawings I have shown one embodiment of the invention. In this showing—

Figure 1 is a front elevation,

Figure 2 is a rear elevation,

Figure 3 is a section on line 3—3 of Figure 1,

Figure 4 is an enlarged fragmentary sectional view of one of the grinding stones and associated elements,

Figure 5 is an enlarged fragmentary sectional view on line 5—5 of Figure 4,

Figure 6 is a plan view of one of the chucks,

Figure 7 is an enlarged detail sectional view on line 7—7 of Figure 3,

Figure 8 is an enlarged fragmentary elevation of the grinding stone and associated parts, showing the stone smoothing means in position,

Figure 9 is a section on line 9—9 of Figure 8, and,

Figure 10 is a horizontal section on line 10—10 of Figure 9.

Referring to the drawings, the numeral 10 designates a relatively heavy cast base forming the main support for the apparatus. This base is provided in its upper face with a depression 11, for a purpose to be described. The base may be surrounded by an angle iron frame 12 to which are secured a plurality of corner posts 13. These posts are connected at their upper ends by a rectangular angle iron frame 14, and between the frames 12 and 14, the end of the apparatus may be closed by plates 15.

The frame 14 supports a pair of upstanding relatively heavy channel members 16 connected at their upper ends by a similar member 17. A horizontal relatively heavy channeled member 18 extends across the supports 16 and is bolted at its ends thereto as at 19. The channeled member 18 forms a support for a plurality of pairs of bearing brackets 20, as shown in Figures 1, 3 and 4. Each of the brackets 20 supports an anti-friction bearing unit 21 to which lubricant may be supplied through a fitting 22. Each pair of bearing units 21 supports a hollow vertical spindle 23 to the upper end of which is secured a pulley 24 around which passes a belt 25 preferably of the V-type. The lower end of each spindle 23 has a plate 26 threaded thereon, and a grinding stone 27 is clamped as at 28 to each plate 26, each grinding stone having an axial opening 29 therethrough.

Means to be described are employed for moving an article of glassware upwardly into engagement with the lower face of each stone 27 to be ground thereby, and water is supplied at the point of grinding. Referring to Figures 1 and 3, the numeral 30 designates a water manifold supplied from a suitable source by a pipe 31 having a control valve 32 therein. The manifold 30 is supported in position by brackets 33, secured to the supports 16, while one of these supports carries a bracket 34 supporting the supply pipe 31. The manifold 30 is provided with a plurality of T's 35, each of which is provided with a control valve 36. One end of a rubber hose 37 is connected to each valve 36 and has its other end connected to the other end of a brass or similar tube 38 extending downwardly through each of the spindles 23. Each tube 38 is supported by a bracket 39 secured as at 40 to the upper flange of the horzontal support 18. Each tube 38 is obviously stationary while the spindles 23 rotate, and accordingly each tube is preferably smaller than the opening through its associated spindle so that these elements do not wear against each other. To prevent the accumulation of water around the tubes 38 within the spindles 23, the latter are preferably provided just above their associated plates 26 with one or more outlet openings 41.

To prevent outward splashing of water, each stone 27 is provided with a hood comprising an inner stationary portion 42 and an outer portion 43 hinged at one side with respect to the section 42 as at 44 and latched at the other side thereto as at 45 (see Figure 5). The stationary portion of each hood is secured against the bottom of one of the bearing brackets 20, as at 46.

A chuck holder indicated as a whole by the numeral 47 is provided for each of the grinding stones and associated elements. This chuck holder is provided with an upper ring portion 48 split at the front thereof as at 49 and one end of the ring adjacent the split is provided with a recess 50 for a purpose to be described. The ring portion 48 of each chuck holder is provided at opposite sides with depending skirt portions 51 connected by a cross member 52 at their lower ends and such cross member is bolted as at 53 to a crosshead 54.

A glass supporting chuck is adapted to be received in the ring 48 of each chuck holder. Each chuck comprises a ring 55 split at one side as at 56 and provided with a depending skirt portion 57 fitting within the ring of the chuck holder. The inner face 58 of the chuck is shaped to correspond to the shape of the article of glassware to be supported thereby. In the drawings, the chuck is shown as being shaped to receive stemmed glassware such as sherbets, champagne glasses, etc., one of such articles of glassware being indicated as comprising a bowl portion 59, a stem 60 and a base 61. The bowl of the glassware is adapted to be supported by a relatively thick felt or similar member 62 arranged in a recess 63 formed in the chuck, the felt 62 forming a cushion extending inwardly beyond the inner surface 58 of the chuck to prevent the bowl 59 from contacting with the metal of the chuck. The chuck is provided adjacent the split 56 with a radial pin 64 arranged in the recess 50 when the apparatus is in operation. In such position of the parts the splits 49 of the chuck holder and 56 of the chuck are in registration to permit the movement therethrough of the stem 60, whereby the article of glassware may be positioned in the chuck.

The chuck 55 and the elements movable therewith are counter-weighted to determine the pressure of the article of glassware against each grinding stone. Each crosshead 54 is provided at its ends with cylindrical bosses 65 receiving the lower end portions of vertical rods 66 secured thereto as at 67. The upper ends of the rods 66 of each pair are connected by a cross member 68 to the center of which is connected a chain 69. Each of these chains passes over a sprocket 70 rotatable on a shaft 71 supported by the upper ends of a bearing bracket 72. The lower ends of these brackets are secured to the transverse support 17. The other end of each chain 69 is provided with a depending stem 73 on which is mounted a main counter-weight 74, supplemental counter-weights 75 being supported on the main counter-weight 74 in accordance with the desired weight to be suspended by the chain 69. It will be apparent that the counter-weights tend to move downwardly, thus tending to move the chucks upwardly to hold the upper edges of the glassware in engagement with the grinding stones 27, the pressure of the grinding engagement depending upon the counter-weights employed.

As previously stated, water is supplied to each of the tubes 38, the latter filling the glassware and leaking over the upper edges thereof. Water, after the glassware has been filled, also overflows through the openings 41, and the water thus discharged from the lower ends of the tubes 38 falls into an elongated trough 76. Above the frame members 14 a tray 77, preferably of aluminum, collects any water which may splash outwardly and causes such water to flow into the trough 76. This trough is provided with an outlet pipe 78 by means of which the water in the trough 76 may be carried off.

Means are provided for lowering the chucks for the purpose of placing glasses therein and for removing the glasses therefrom. The lower ends of each pair of rods 66 are provided with a transverse connecting member 79 through the center of which is connected the upper end of a vertical pull rod 80. Such rod extends down-

wardly through the bottom of the trough 76 and is surrounded by an upstanding bearing 81 carried by the bottom of the trough to minimize any leakage of water around the pull rod. The lower end of each rod 80 is provided with a yoke 82 pivotally connected as at 83 to the inner end of a lever 84, and operation of this lever in a manner to be described pulls the associated chuck downwardly for the purpose stated. A plurality of vertical supports 85 are carried by the bottom of the pan 76 and a vertical rod 86 extends through each support 85. One of the rods 86 is in axial alinement with each of the grinding spindles, and its upper end is adapted to engage the bottom of an article of glassware, upon the lowering of the associated chuck to release the glassware from the chuck. According to the height of the glassware, each rod 86 may be adjusted as to height by an adjusting collar 87.

A plurality of pairs of vertical angle irons 88 are bolted at their lower ends as at 89 to a transverse bar 90 extending between the two corner forward posts 13. The upper ends of the angle irons 88 are secured as at 91 to a horizontal angle iron 92 also secured at its ends to the corner post 13. A pair of the angle irons 88 is employed for each grinding unit, and the forward end of each lever 84 is pivotally connected as at 93 between the angle irons 88 of one pair. Either or both of the pivotal connections 83 or 93 may be sufficiently loose to permit the vertical axial movement of the rods 80.

A depending link 94 is pivotally connected at its upper end as at 95 to each of the levers 84, and is pivotally connected at its lower end as at 96 to an operating lever 97. The rear end of each operating lever 97 is pivotally connected as at 98 between a pair of vertically extending spaced angle irons 99, secured at their lower ends to the frame 12 and at their upper ends to a transverse connection 100 extending between the rear leg members 14. The forward end of each operating lever 97 is provided with a treadle 101.

It will be apparent that downward movement of either treadle 101 will transmit movement through the link 94 and lever 84 to the associated glass supporting chuck, and means is provided for limiting the movement of the parts to prevent engagement of each chuck with its associated stone if the chuck is released without an article of glassware arranged therein. A vertical bar 102, preferably square in cross-section, has its lower extremity forked to engage the outer end portion of each of the levers 97 and it is slidable in a guide 103 connected to the adjacent pair of angle irons 88. The upper end of each bar 102 is provided with a threaded extension 104 extending slidably through the horizontal flange of the angle iron 92 and through a horizontal plate 105, spaced above the angle iron 92 and connected at its ends to the forward corner posts 13. A nut 106 is arranged on each threaded extension 104 in the space between the horizontal flange of the angle iron 92 and the plate 105, these elements preventing vertical movement of the nut, as will be apparent. Accordingly rotation of the nut determines the vertical position of each bar 102, and consequently determines the upper limit of movement of each lever 97.

Each of the levers 97 may be locked in its lowermost position. Referring to Figure 1, the numeral 107 indicates a plurality of locking levers each pivotally connected intermediate its ends as at 108 to the vertical flange of the angle iron 92 and the upper end of each lever 107 is provided with an outwardly extending operating handle 109. Each lever 107 lies approximately in the plane of the outer flanges of the pairs of vertical angle irons 88, and each lever 107 is provided at its lower end with a laterally extending fork 110 receiving the adjacent outer flange of one of the angle iron supports 88. The outer arm of each fork 110 is adapted to assume a position over one of the levers 97 to lock the latter in its lower position, as shown in dotted lines in Figure 3.

Means are provided for driving the spindles 23, and in the drawings, one source of power has been illustrated as being provided for each pair of spindles. It will be apparent, however, that the number of power sources employed is unimportant so far as the present invention is concerned. The horizontal support 18 is provided with a pair of rearwardly extending supports 111 bolted thereto as at 112. Each support 111 is provided with a horizontal upper wall 113 in the upper face of which is formed a guideway 114, a plate 115 forming the top of the guideway at each side thereof. A crosshead indicated as a whole by the numeral 116 has the edges of its base portion slidable in the guideways of each support 111, and carries an upstanding support 117 carrying a bearing 118. Each bearing 118 supports a shaft 119 carrying a pulley 120 adjacent each end thereof. The belts 25, carried by the spindles 23, pass around the respective pulleys 120 to be driven thereby. It will be apparent that the two spindles at each end of the apparatus will be driven from one of the shafts 119.

Each support 111 is provided with an outwardly and upwardly extending arm 121 in which is rotatably mounted a shaft 122, and this shaft is provided at its outer end with a wheel 123 having a handle 124. The inner end of this shaft 122 is threaded in a lug 125 carried by the base of the crosshead 116, and accordingly it will be apparent that the handle 124 and wheel 123 may be rotated to move the crosshead 116 and thus properly tension the belts 25.

In the present embodiment of the invention a separate motor is employed for driving each of the shafts 119, and variable speed transmission means is preferably provided between each motor and the shaft 119 driven thereby. Referring to Figures 2 and 3, the numeral 126 designates a pair of independent supporting plates each hinged at its inner end as at 127 to a relatively heavy plate 128, arranged in a vertical plane and extending across the apparatus. The plate 128 is bolted at its ends as at 129 to the vertical supports 16. It will be noted that the plate 128 is arranged against the bottom of the horizontal channeled support 18 and forms a continuation of the base portion of the latter. These elements therefore provide a wall separating the grinding side of the apparatus from the driving side thereof, thus preventing any cuttings or the like from the grinding operation from coming into contact with the driving apparatus.

Each supporting plate 126 is provided with a depending lug 129' to which is swiveled a block 130. A screw 131, having a handle 132, has its upper end rotatably supported by each block 130 and is threaded in a block 130' swiveled to an outstanding lug 132' carried by the adjacent horizontal frame member 14. Downward move-

ment of the other end of each supporting plate 126 is limited by a screw 133 (Figure 2) threaded in a bracket 134 also carried by the adjacent horizontal frame member 14.

Each supporting plate 126 carries a motor 135 adjacent one end thereof as shown in Figure 2. Each motor drives a shaft 136 on which is mounted a pair of relatively axially movable driving cones 137, urged toward each other by compression springs 138, the end of each shaft 136 remote from its associated motor 135 being supported in a bearing 139 carried by the associated plate 126. A belt 140 passes around each pair of cones 137 and around a pulley 141 carried by each shaft 119. The specific structure of the cones 137 and associated parts form no part of the present invention except in the combination claimed, such elements being fully disclosed in my copending application Serial No. 84,941, filed June 12, 1936, now Patent No. 2,107,483, dated February 8, 1938.

The apparatus is provided with means for smoothing the stones 27 after the latter have become grooved or roughened in use. The chuck holders described are adapted to support the means for cutting and smoothing the stones. Referring to Figures 8, 9 and 10, the numeral 142 designates a cylindrical member fitting and receivable in either of the chuck holders and provided with a pin 143 projecting from one side thereof and adapted to be arranged in the recess 50, previously described. The skirt 142 is formed integral with a horizontal member 144 which is supported on the ring 48 of the chuck holder when in operative position. A pair of parallel guides 145 is formed integral with the member 144 and is provided in opposite ends with bearing portions 146 and 147 rotatably supporting a shaft 148. The portion of the shaft which extends through the bearing 146 is shouldered as at 149, and the adjacent projecting extremity of this shaft is provided with a collar 150. Accordingly the shaft is prevented from moving longitudinally, but is free to rotate. The shaft 148 is provided with a wheel 151 having a handle 152 projecting therefrom to facilitate the rotation of the shaft.

A diamond point or similar cutting implement 153 is supported by a holder 154 having outstanding flanges 155 slidable on the upper faces of the guides 145. The holder 154 is further provided with a depending block 156 slidable between the guides 145 and threaded on the shaft 148. A shield 157 is carried by the holder 154 and is provided at its edges with depending flanges 158 extending downwardly beyond the upper outer edges of the guides 145. The ends of the shield 157 are turned upwardly as at 159, and the shield is sufficiently elongated to prevent cuttings from dropping between the guides 145.

The shield 42 is provided with a bracket 160 secured thereto as at 161, and an internally threaded bearing 162 is carried by this bracket. A stem 163 is threaded in the bearing 162 and carries a knurled head 164 at its upper end. The lower end of the screw 163 is adapted to contact with an arm 165 extending laterally from the member 144 and preferably formed integral therewith. The contact of the arm 165 with the screw 163 limits the upward movement of the stone cutting implement.

The operation of the apparatus is as follows:

The spindles 23 are driven by the motors 135, as will be apparent. Each motor drives one of the pair of cones 137, and the belts passing around these cones drive the shafts 119 through the belts 140. Power is transmitted from each shaft 119 to the spindles associated therewith by means of the belts 25. The rotational speed of the spindles readily may be varied by rotating the handles 132. This operation obviously raises or lowers the supporting plates 126, thus varying the distance between the shafts 119 and 136. The minimum driving speed of the spindles is reached when the supporting plates 126 are in their lower or horizontal position in engagement with the screws 133, under which conditions, the increased distance between the shafts 119 and 136 causes the belts 140 to move inwardly toward the centers of the cones 137. The positions of the parts for the minimum driving speed are shown at the left side of Figure 2. For an increased driving ratio, one or both of the handles 132 may be rotated to elevate the supporting plates 126, as shown at the right hand side of Figure 2. Under such conditions the distance between the shafts 119 and 136 will be reduced, thus permitting the springs 138 to move the cones 137 inwardly whereby the belt 140 will engage the cones 137 adjacent the periphery thereof. The two supporting plates 126 obviously are independently adjustable, thus permitting two of the spindles to be driven at a higher rate of speed than the other two spindles, if desired.

When it is desired to grind an article of glassware, one of the treadles 101 may be depressed to lower the associated chuck, whereupon the article of glassware is inserted in position in the chuck. In the case of stem ware, the splits 56 of the chuck and 49 of the chuck holder permit the entrance of the stem directly into the chuck, whereupon the article may be lowered to permit the bowl portion thereof to be supported by the felt member 62. It will be apparent that various chucks are employed in accordance with the article of glassware.

With the article in position in the chuck, the operator permits the treadle 101 to move upwardly, the counter-weights 74 and 75 effecting such movement until the upper edge of the glassware comes into engagement with the rotating stone 27. The pressure at which the glassware is maintained against the stone is determined by the counter-weights. Particular attention is invited to the fact that the nature of the chuck is such that an article of glassware will automatically center itself in the chuck and axially align itself with respect to the spindle which drives the stone. Accordingly the glass will be ground in a true horizontal plane.

During the grinding operation, water is fed downwardly through the pipe 33 and through the opening 29 in the center of the stone, such water quickly filling the bowl of the glassware to maintain it in a cool condition during the grinding operation. This fact is of substantial importance since the effective cooling of the glassware thus provided minimizes breakage to a remarkable extent. Excess water overflows through the openings 41 (Figure 4) thus preventing the building up of a column of water in the spindle and the overflowing of the water from the top of the spindle. Some of the water obviously will leak over the edge of the glassware, particularly before the grinding is completed, and all of the discharging of the water takes place within the shield members 42 and 43. The shield members prevent the outward splashing of the water, and the water is discharged wholly beneath the operating parts of the spindle, such as the supporting bearings thereof. The cuttings, of course, pass downward-

ly from the shield members with the water, and thus all operating parts of the apparatus are protected from the action of water and from the abrasive action of the cuttings.

Water passing downwardly from the shield members flows into the trough 46, from which it is preferably constantly drained by the pipe 78. Obviously the level of the water in the trough never reaches the upper ends of the bearings 81 and supports 85, and practically no water leaks through these members. Over substantial periods of operation, the amount of water leaking around the stems 80 and 86 will be insufficient to fill the shallow recess 11 of the base 10, the recess being provided to collect what negligible leakage occurs.

The grinding operation for each article of glassware is carried out to the extent necessary to grind the edge of the glass to the proper point, and the extent to which the grinding operation will be carried out is limited by the stop members 102. These members are adjusted by rotating the nuts 103 to limit the upward movement of the levers 97, and thus limit the upward movement of the glassware as the grinding operation progresses. When one of the levers 97 contacts with the lower end of its stop member 102, the grinding of the glass in the associated chuck is completed.

After an article has been ground to the desired extent, the associated treadle 101 is depressed, whereupon the lever 97 pulls the lever 84 downwardly together with the associated chuck, the operator exerting sufficient pressure on the treadle to overcome the counterbalancing effect of the counter-weights. The chuck supporting the ground article will be lowered until the rod 86 contacts with the bottom of the glassware, whereupon the latter will be loosened from the chuck and readily may be removed by hand. While the chuck is still in lowered position, another glass article may be placed in position therein to be ground in the manner stated.

Any number of grinding units may be employed and in the present instance four units have been illustrated. Accordingly, an efficient apparatus has been provided for use by one operator, the desired operation consisting in filling the successive chucks from one end of the machine, and then starting from the same end of the machine to progressively remove the ground articles and replace them with articles to be ground.

As previously stated, the present apparatus constitutes in several respects an improvement over prior structures of which I am aware. For example, in some constructions which have been commercially used, the glass article is moved downwardly against the upper face of a rotating stone, in which case the cooling water and cuttings find their way into the supporting bearings of the spindle, as well as other operating parts, thus causing mechanical difficulties and shortening the life of the apparatus. Moreover, an insufficient cooling effect is maintained in an apparatus of this character due to the inversion of the article of glassware rendering it incapable of holding water. In the present case, the glass ware is supported in normal position and promptly becomes filled with water to be maintained in a cooled condition during the grinding operation, thus greatly minimizing breakage due to overheating. Moreover, the grinding operation and the discharging of water and cuttings occurs beneath the spindle bearings, while the shield members 42 and 43 and the wall comprising the members 18 and 128 between the grinding side and driving side of the apparatus afford protection for the driving units.

In another prior form of apparatus, the grinding spindle is arranged horizontally, thus requiring that the glass be arranged in a horizontal position for movement against the stone. Great difficulty has been experienced in supporting glassware in an apparatus of this character, substantial breakage occurring through the difficulty in properly supporting the ware. Since it is difficult to balance glassware in an apparatus of such character, the grinding operation usually takes place unevenly, it being extremely difficult to provide a ground upper edge which lies in a horizontal plane when the glass is in normal position.

In the present apparatus, the grinding takes place with the articles in their normal position, and the nature of the spindle and the supporting of the articles adjacent the upper ends thereof causes the ware to center and gravitate to a correct position for grinding in the desired plane.

The several chucks may be readily locked in their lower positions when desired, for example, when it is desired to place in inoperative position the stone smoothing means shown in Figures 8, 9 and 10. Either of the treadles 101 may be depressed, whereupon the handle 109 of the corresponding lever 107 may be moved in the proper direction to engage the associated fork 110 with the depressed lever 97. This lever thus will be held in its lower position, and the associated chuck will be held in a corresponding position.

When either of the stones becomes grooved or roughened, the corresponding chuck holder is moved to its lower position and locked in such position in the manner just described. The corresponding chuck is removed from its holder by rotating it slightly to move the pin 64 out of the recess 50, whereupon the chuck may be lifted from position. The stone smoothing unit then may be placed in position by aligning the pin 143 (Figures 8 and 9) with the split 49 in the chuck holder, lowering the sleeve 142 in position, and then rotating the unit to engage the pin 143 in the recess 50. The screw 163 is then adjusted to engage the arm 165 with the cutting point 153 arranged approximately as shown in Figure 9, very slightly above the lower face of the stone. The handle 152 is then revolved to gradually move the block 156 inwardly, together with the holder 154 and cutting point 153. The inward movement is continued until the cutting point reaches the opening through the center of the stone. This operation may be repeated as many times as necessary to completely smooth the lower surface of the stone, the screw 163 being moved upwardly to a slight extent for each repetition of the operation to guide the cutting point for perfect horizontal movement.

When the stone smoothing operation is completed, it will be obvious that the lower face of the stone will be smooth and trued in a plane perpendicular to the axis of the associated spindle. The chuck holder then may be lowered and latched in its lower position to permit the removal of the stone smoothing device, whereupon the glass supporting chuck may be replaced in position for further grinding operations. Accordingly it will be apparent that the apparatus employs the same chuck holders for supporting chucks and for supporting the stone smoothing mechanism, thus increasing the efficiency of the apparatus and minimizing the cost of extra operations for smoothing the stones. Each appa-

ratus need be provided with only one stone smoothing mechanism, as will be apparent.

It is to be understood that the forms of the invention herewith shown and described are to be taken as preferred examples of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A grinding apparatus comprising a vertical rotatable spindle, a grinding stone supported at the lower end of said spindle, a glassware receiving chuck arranged beneath said stone, means for supplying water to the edge of an article of glassware supported by said chuck against the lower face of said stone, a stationary water trough arranged beneath said chuck, an upstanding bearing carried by said trough, and a rod vertically movable in said bearing and supporting said chuck.

2. A grinding apparatus comprising a vertical rotatable spindle, a grinding stone supported at the lower end of said spindle, a glassware receiving chuck arranged beneath said stone, means for supplying water to the edge of an article of glassware supported by said chuck against the lower face of said stone, a water trough arranged beneath said chuck, an upstanding bearing carried by said trough, a rod vertically movable in said bearing and supporting said chuck, lever means for vertically moving said rod, including a treadle movable downwardly to move said rod downwardly, and means biasing said rod upwardly.

3. A grinding apparatus comprising a vertical rotatable spindle, a grinding stone supported at the lower end of said spindle, a glassware receiving chuck arranged beneath said stone, means for supplying water to the edge of an article of glassware supported by said chuck against the lower face of said stone, a water trough arranged beneath said chuck, an upstanding bearing carried by said trough, a rod vertically movable in said bearing and supporting said chuck, lever means for vertically moving said rod, including a treadle movable downwardly to move said rod downwardly, means biasing said rod upwardly, and means for latching said treadle in lower position.

4. A grinding apparatus comprising a vertical rotatable spindle, a grinding stone supported at the lower end of said spindle, a glassware receiving chuck arranged beneath said stone, means for supplying water to the edge of an article of glassware supported by said chuck against the lower face of said stone, a water trough arranged beneath said chuck, an upstanding bearing carried by said trough, a rod vertically movable in said bearing supporting said chuck, lever means for vertically moving said rod, including a treadle movable downwardly to move said rod downwardly, means biasing said rod upwardly, and adjustable means engaging said lever means for limiting the upward movement of said rod and said chuck.

5. A grinding apparatus comprising a vertical rotatable spindle, a grinding stone supported at the lower end of said spindle, a glassware receiving chuck arranged beneath said stone, means for supplying water to the edge of an article of glassware supported by said chuck against the lower face of said stone, a water trough arranged beneath said chuck, an upstanding bearing carried by said trough, a rod vertically movable in said bearing and supporting said chuck, lever means for vertically moving said rod, including a treadle movable downwardly to move said rod downwardly, means biasing said rod upwardly, a pulley arranged above said chuck, a flexible element passing over said pulley and having two depending ends one of which is connected to said chuck, and a counter-weight carried by the other end of said flexible element.

6. A work holder for a grinding apparatus having a spindle and a grinding stone carried by said spindle, said holder being mounted for movement parallel to the axis of said spindle and comprising a ring portion at right angles to the axis of said spindle and having a split in one side thereof, said ring portion being provided within said split with a recess, and an article holding structure comprising a portion adapted to seat on said ring portion, a skirt portion receivable within said ring portion, and a pin carried by said structure and engageable in said recess for definitely positioning said structure with respect to said ring portion.

7. A work holder for a grinding apparatus having a spindle and a grinding stone carried by said spindle, said holder being mounted for movement parallel to the axis of said spindle and comprising a ring portion at right angles to the axis of said spindle and having a split in one side thereof, said ring portion being provided within said split with a recess, and a chuck comprising a flange portion adapted to seat on said ring portion, a skirt portion receivable within said ring portion, and a pin engageable in said recess, said chuck having a radial split therein aligning with the split in said ring portion when said pin is arranged in said recess.

8. A work holder for a grinding apparatus having a spindle and a grinding stone carried by said spindle, said holder being mounted for movement parallel to the axis of said spindle and comprising a ring portion at right angles to the axis of said spindle and having a split in one side thereof, said ring portion being provided within said split with a recess, and a chuck having a split ring portion including an upper flange portion adapted to seat on said first named ring portion and a skirt receivable within said first named ring portion, a pin carried by said chuck and engageable in said recess when the splits in said ring portions are in registration, the inner surface of said chuck being tapered to decrease in size away from said grinding stone, and a cushion element projecting inwardly from the inner face of said chuck.

9. A grinding apparatus comprising a plurality of vertical rotatable spindles, a grinding stone supported at the lower end of each spindle, a glassware receiving chuck arranged beneath each stone, means for supplying water to the edge of an article of glassware supported by each chuck, a stationary water trough arranged beneath said chucks, a plurality of vertical bearings carried by said trough and corresponding in number and arrangement to said chucks, and a rod vertically movable in each bearing and supporting one of said chucks.

10. A grinding apparatus comprising a plurality of vertical rotatable spindles, a grinding stone supported at the lower end of each spindle, a glassware receiving chuck arranged beneath each stone, means for supplying water to the edge of an article of glassware supported by each chuck, a stationary water trough arranged beneath said chucks, a plurality of upstanding bearings carried by said trough and correspond-

ing in number and arrangement to said chucks, a rod vertically movable in each bearing and supporting one of said chucks, treadle lever means for vertically moving each of said rods, and means biasing each of said rods upwardly.

11. A grinding apparatus comprising a plurality of vertical rotatable spindles, a grinding stone supported at the lower end of each spindle, a chuck arranged beneath each stone, means for supplying water to the edge of an article supported by each chuck against the lower face of the associated stone, a single stationary water trough extending beneath all of said chucks, a plurality of upstanding bearings carried by said trough, and a rod vertically movable in each bearing and supporting one of said chucks.

12. In a grinding apparatus comprising a vertical spindle and a grinding stone supported at the lower end of said spindle, the improvement which comprises a ring arranged beneath and in axial alinement with said spindle and provided with a slit extending throughout the length of one side thereof, a chuck engageable with said ring to be supported thereby in axial alinement therewith, said chuck having a slit extending throughout the length of one side thereof in registration with the slit in said ring to facilitate the entrance of an article of glassware into said chuck, said chuck being constructed to receive and engage an article of glassware solely near the top thereof, and vertically movable means for supporting said ring, said supporting means being circumferentially spaced from said slits and being horizontally offset from said ring.

13. A work holder for a grinding machine, comprising a supporting ring having a slit extending throughout the length of one side thereof, a chuck of ring-like shape engageable with said ring to be supported thereby coaxially therewith, said chuck having a slit extending throughout the length of one side thereof, and interengaging means between said ring and said chuck for maintaining said slits in registration with each other to facilitate radial movement of the work into position in said chuck.

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