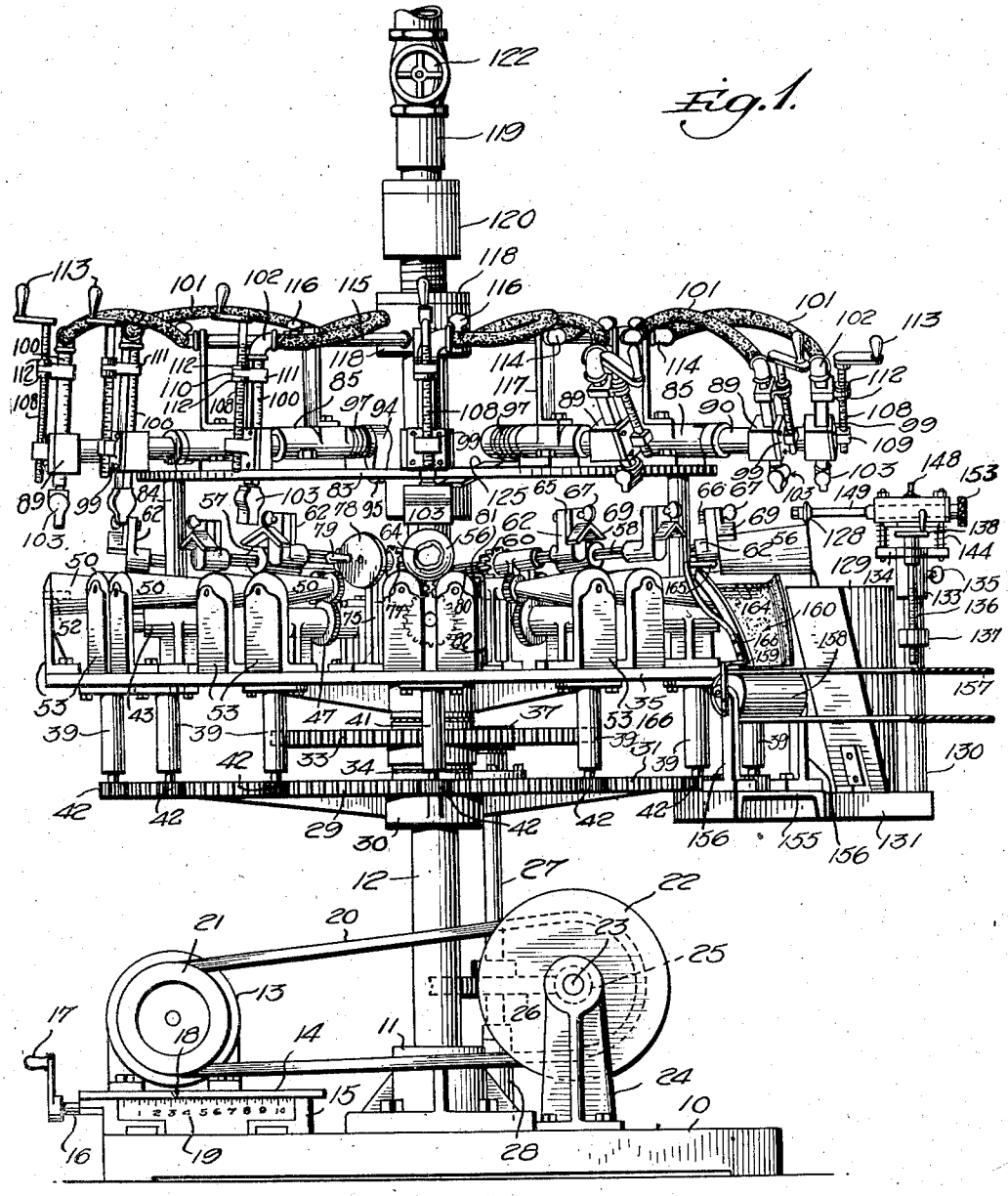
Oct. 31, 1939. A. B. KNIGHT 2,177,807

CRACKING-OFF MACHINE

Filed Jan. 28, 1937 5 Sheets-Sheet 1

Fig. 1.



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CRACKING-OFF MACHINE

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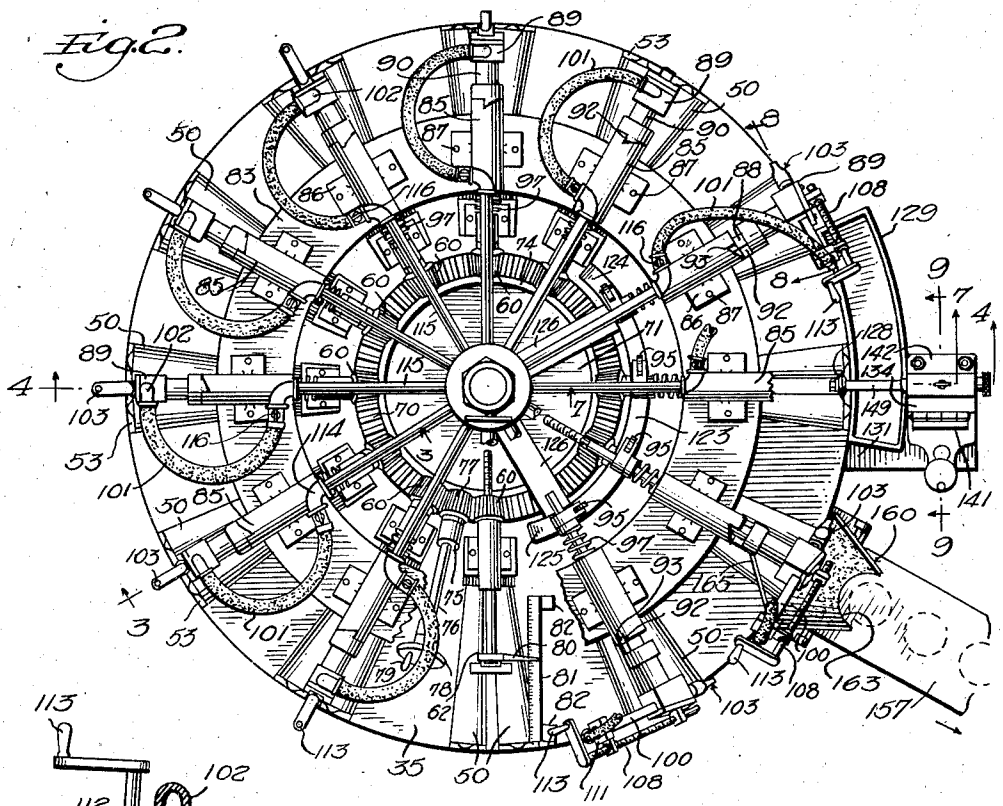
Fig. 2.



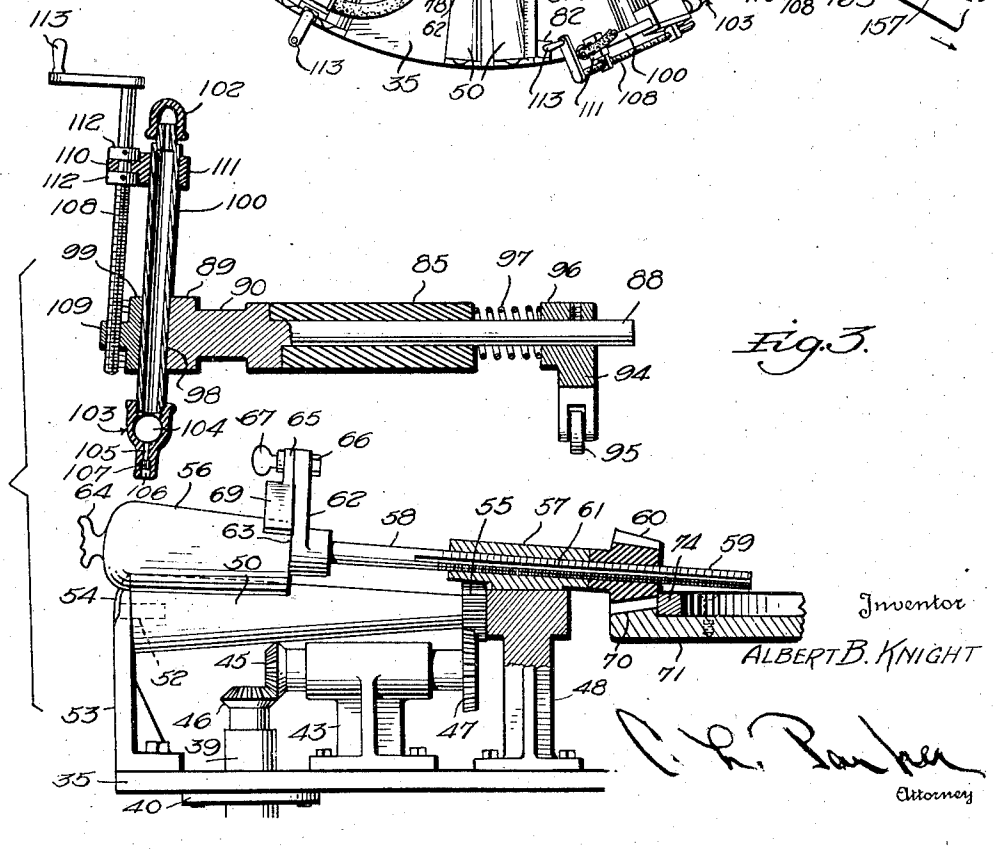


Fig. 3.

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CRACKING-OFF MACHINE

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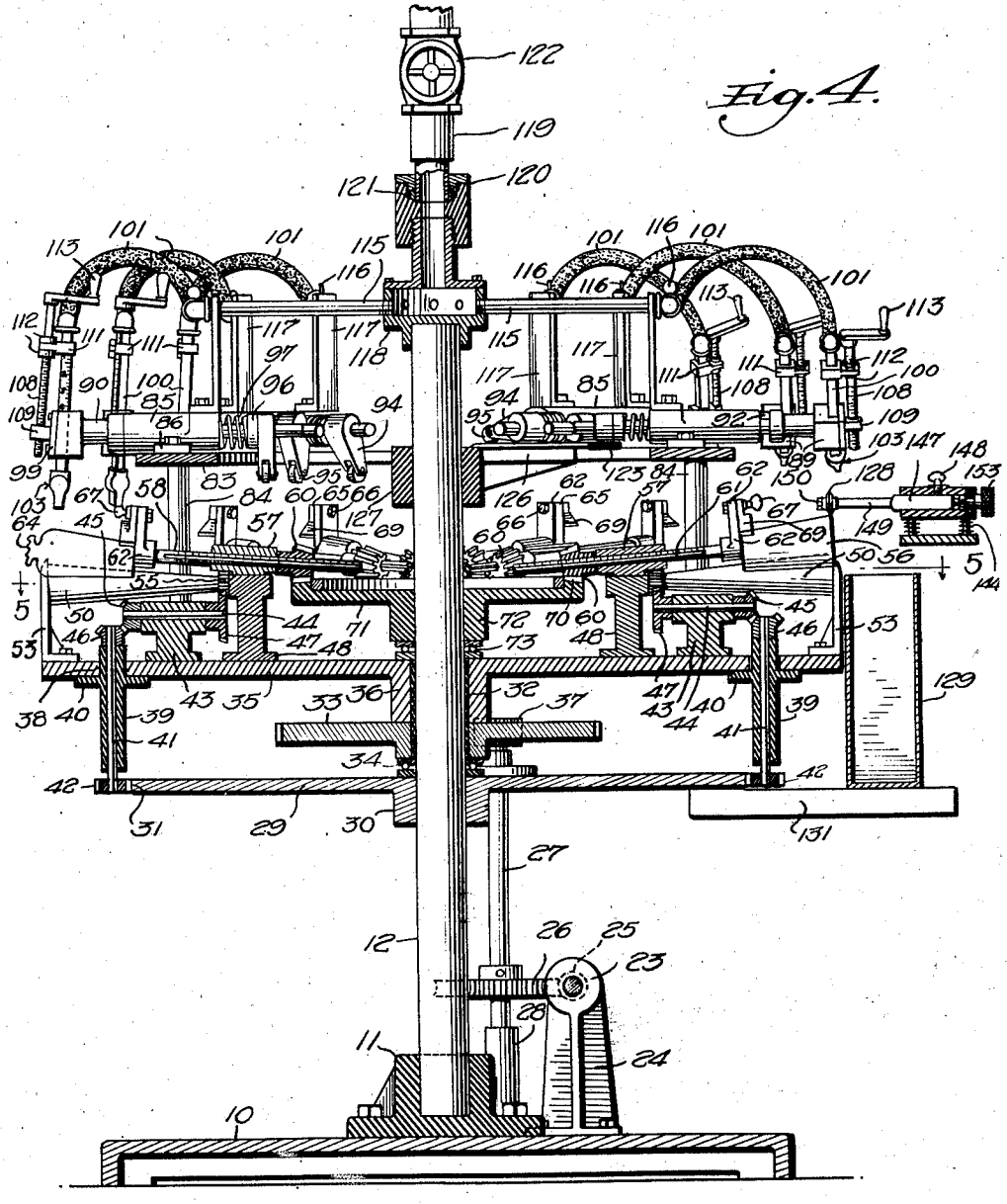
Fig. 4.



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CRACKING-OFF MACHINE

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Fig. 5.

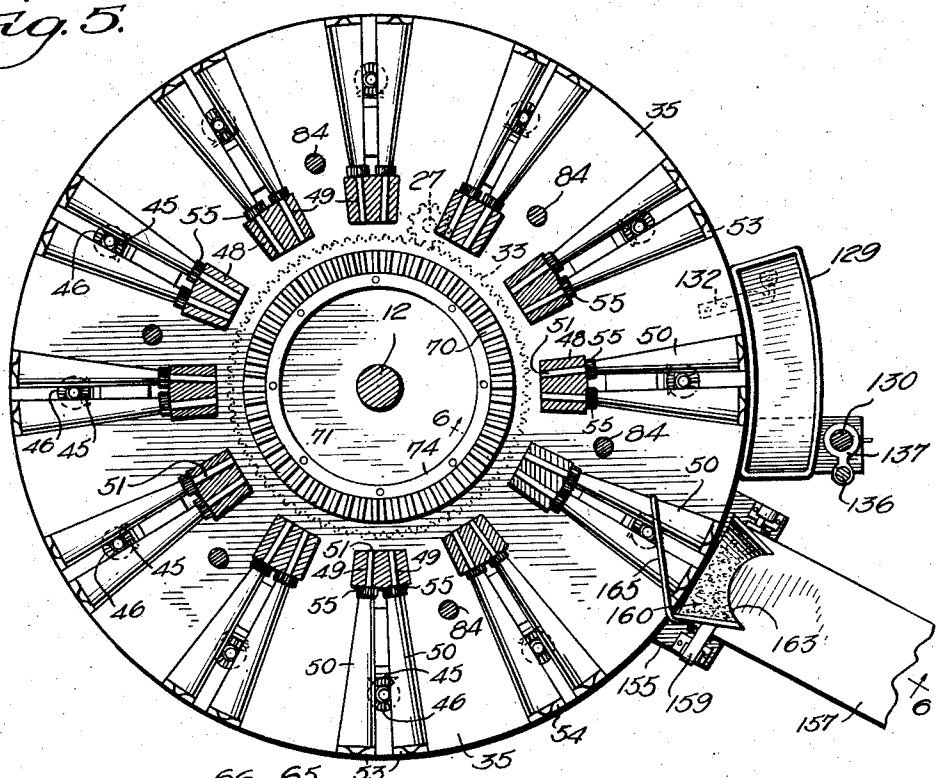

Fig. 6.

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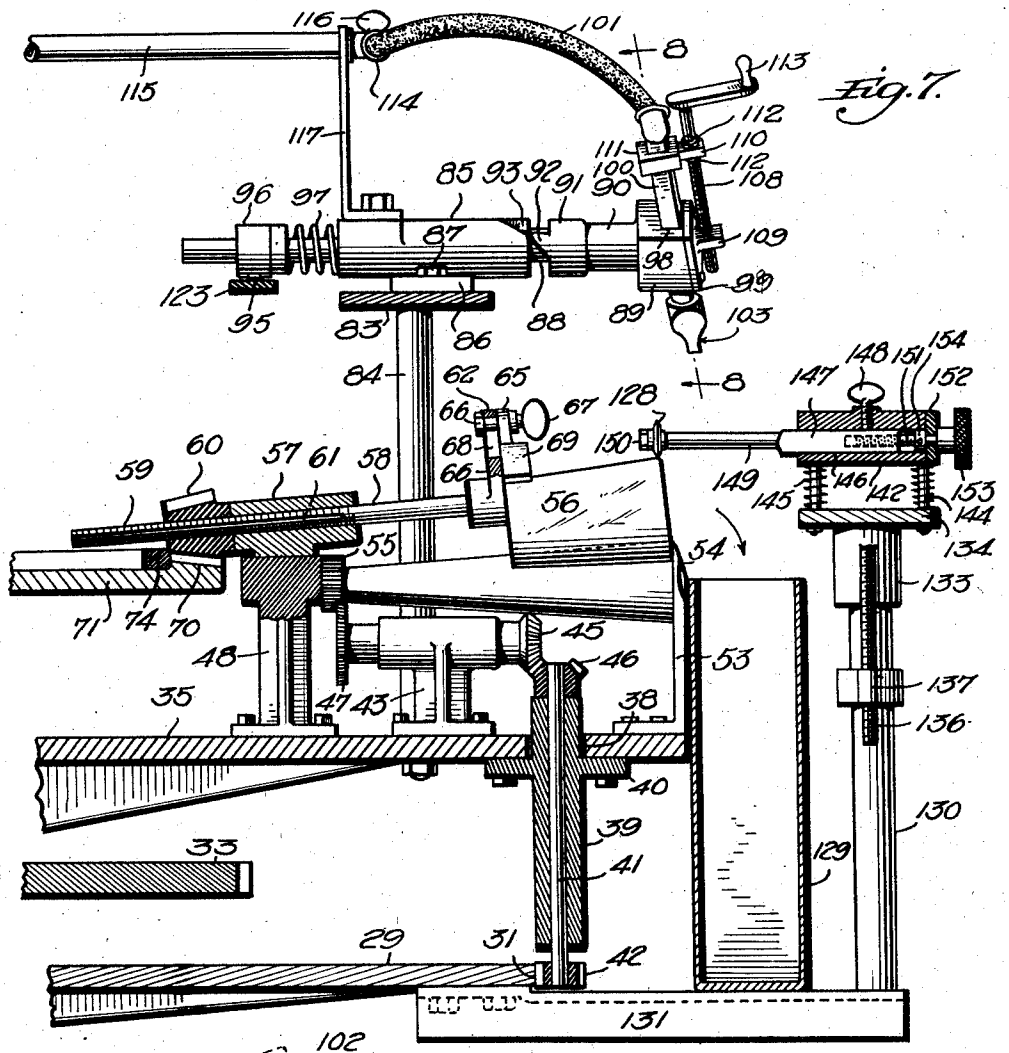

Fig. 7.

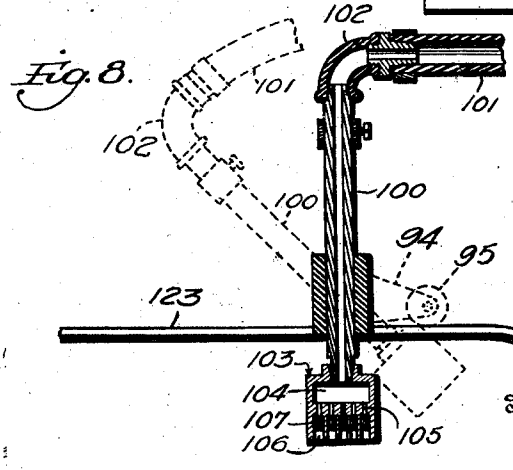

Fig. 8.

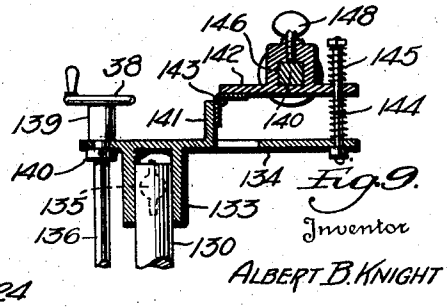

Fig. 9.

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UNITED STATES PATENT OFFICE

2,177,807

CRACKING-OFF MACHINE

Albert Breakenridge Knight, Fairmont, W. Va.

Application January 28, 1937, Serial No. 122,882

18 Claims. (Cl. 49—50)

This invention relates to cracking off machines, and more particularly to a machine automatically operative for cracking off the cullets from tumblers and similar articles of glassware.

The methods employed in blowing tumblers and similar articles of glassware are well known, and after the iron has been broken off upon the completion of the blowing operation, it is necessary to crack off the cullet or excess glass at the approximate edge of the finished article. This operation for many years has been performed by rigidly supporting the glassware and rotating it against a diamond cutting point to etch a line around the ware in a plane at right angles to the axis thereof. The ware is then subjected to the action of a burner which heats and expands the glass adjacent the etched line, thus causing it to crack off on such line.

The glass cracks off only fairly accurately in the plane of the etched line, the cracked off edge being ordinarily slightly wavy and irregular and not lying in a plane at right angles to the axis of the ware, due to the irregularity of the cracking action. After the cracking off operation, it is the common practice to grind the edge of the ware to a flat surface, and then glaze the ware by subjecting the ground edge thereof to the action of a heating burner to soften the glass and cause the edge thereof to flow into a smooth polished surface.

The former cracking off method referred to is necessarily extremely slow due to the necessity for rigidly supporting each individual article of glassware, etching the line around the ware while holding it rigidly in position, and then transferring the etched ware to the cracking off burner. In a factory manufacturing a large number of articles of glassware, the etching and cracking off operations require a substantial number of operators, thus greatly increasing the cost of the ware. Moreover, the edge of each article, where cracked off, is sufficiently irregular to require that the ware be ground prior to glazing.

An important object of the present invention is to provide a method of cracking off glassware without the necessity of etching a line around the ware to determine the point at which the ware will be cracked off.

A further object is to provide a method which is capable of being practiced without rigidly supporting the ware either before or during the cracking off operation, thus greatly increasing production and reducing the cost of the ware.

A further object is to provide a novel apparatus for cracking off articles of glassware without rigidly supporting the ware or etching a line around the ware to determine the point at which the ware will be cracked off.

A further object is to provide an apparatus having simple glass supporting devices each adapted to support an article of glassware without being gripped thereby, and to provide novel means operative in conjunction with the glass supporting devices for accurately cracking off the ware.

A further object is to provide an apparatus of the character referred to wherein the glass supporting devices are provided with means for heating the glass articles around narrow lines, and wherein the supporting devices are relatively movable with respect to a crack-initiating element to crack off successive glass articles.

A further object is to provide an apparatus of this character which is automatically continuous in its operation, and wherein large numbers of glass articles may be cracked off with the use of a single operator to feed the apparatus.

A further object is to provide a novel take-off and conveying means for the successive glasses as they are cracked off, thus eliminating the necessity for the provision of an operator to remove the cracked-off ware from the machine.

A further object is to provide novel means for swinging the burners to inoperative position prior to the engagement of the successive glass articles with the crack-initiating device to prevent the latter from being subjected to the action of the burner, and to permit an operator to safely feed successive articles of glassware to the apparatus.

A further object is to provide novel means for adjusting the apparatus to crack off glass articles according to their desired length.

A further object is to provide an apparatus adapted to simultaneously support a plurality of glass articles for the purpose stated, and to provide means for simultaneously adjusting the glass supporting devices according to the desired length of the glass articles.

A further object is to provide novel glass supporting devices which are adapted to support the glass articles on their sides and to normally feed the articles against a stop to determine the length at which the ware will be cracked off.

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 side elevation of the apparatus,

Figure 2 is a plan view of the same,

Figure 3 is an enlarged detail sectional view on line 3—3 of Figure 2, parts being shown in elevation,

Figure 4 is a central vertical sectional view through the apparatus taken substantially on line 4—4 of Figure 2,

Figure 5 is a horizontal sectional view taken substantially on line 5—5 of Figure 4,

Figure 6 is an enlarged fragmentary vertical sectional view on line 6—6 of Figure 5,

Figure 7 is a similar view on line 7—7 of Figure 2,

Figure 8 is an enlarged detail sectional view on line 8—8 of Figure 2, and,

Figure 9 is a similar view on line 9—9 of Figure 2.

Referring to Figures 1 and 4, the numeral 10 designates a relatively heavy cast base which supports the entire apparatus, as will become apparent. A socket 11 is bolted on the base and receives the lower end of a relatively heavy vertical standard 12. It will be noted that the socket 11 supports the shaft 12 and fixes the latter against rotation. Aside from the power source and transmission for driving the apparatus, all of the parts of the apparatus are supported by the standard 12.

A motor 13 is mounted on a base 14 slidable in suitable guides 15 secured to the main base 10. A screw shaft 16, operable by a crank 17, is adapted to adjust the motor 13 with respect to the guides 15 to determine the transmission ratio, as will become apparent. A pointer 18, carried by the motor 13, moves over a scale 19 to indicate the driving ratio. This mechanism per se, forms no part of the present invention and, together with the variable transmission to be described, may be constructed in accordance with the disclosure in my copending application Serial No. 89,941, filed June 12, 1936.

A belt 20 passes around the pulley 21 of the motor and around a pair of cone pulleys 22, which are urged toward each other by spring means (not shown), preferably of the type disclosed in my copending application referred to. The spring means urge the cones 22 toward each other and thus urge the belt 20 radially outwardly with respect to the cones, the effective diameter of these cones being determined in accordance with the adjusted position of the motor 13.

The cones 22 are keyed or otherwise secured to a shaft 23 supported on the base 10 by bearings 24. The shaft 23 carries a worm 25 (Figure 4) meshing with a worm wheel 26 mounted upon a vertical shaft 27. The lower end of this shaft is supported in a bearing 28 carried by the base 10.

A horizontal circular plate 29 is spaced above the base 10 and is provided with a hub 30 rigidly secured to the standard 12. The plate 29 is provided with a peripheral ring gear 31 for a purpose to be described. A bearing sleeve 32 is rotatable on the standard 12 above the plate 29. A ring gear 33 is rigidly secured to the sleeve 32 and is supported on the plate 29 by a thrust bearing 34. A circular supporting plate 35 is arranged above the ring gear 33 and is provided with a hub 36 rigidly secured to the sleeve 32. It will be apparent that the gear 33 and plate 35 rotate about the axis of the standard 12, and the ring gear 33 is driven by a pinion 37 carried by the upper end of the shaft 27.

The supporting plate 35 is provided with a plurality of circumferentially spaced openings 38 in which are arranged the upper ends of vertical bearings 39 each bearing having a flange 40 by means of which it is secured with respect to the plate 35. The bearings 39 are concentrically arranged with respect to the standard 12 and ring gear 29, and each bearing rotatably supports a vertical shaft 41 carrying a pinion 42 at its lower end meshing with the ring gear 31. Accordingly it will be apparent that as the supporting plate 35 rotates about the axis of the standard 12, each shaft 41 is rotated on its own axis.

The plate 35 supports a bearing 43 on its upper face adjacent the upper end of each shaft 41. Each bearing 43 rotatably supports a horizontal shaft 44 arranged radially with respect to the standard 12. Each shaft 44 carries a bevel gear 45 at its outer end meshing with a similar gear 46 carried by the upper end of the corresponding shaft 41. It will be noted that the bottom of each bevel gear 46 engages the upper end of the corresponding bearing 39, and thus it will be apparent that the bevel gears 46, shafts 41 and pinions 42 are supported by the respective bearings 39. Rotation of each shaft 41 on its own axis, in the manner referred to, drives the corresponding shaft 44, and each of these shafts carries a drive gear 47 at its inner end, for a purpose to be described.

The plate 35 supports a bearing 48 radially inwardly of each of the bearings 43, and each bearing 48 is provided at its upper end with a pair of bearing openings 49 (Figure 5) which are substantially radial with respect to the standard 12, for a reason which will become apparent. A pair of conical rollers 50 is associated with each bearing 48, each of the rollers 50 being provided at its inner end with a shaft 51 rotatable in one of the bearing openings 49. The outer ends of the rollers 50 are provided with axial pins or stub shafts 52 (Figure 6) rotatable in the upper ends of brackets 53. The upper end of each bracket 53 is substantially semi-circular and has its upper face curved inwardly as at 54 to terminate in a semi-circular line lying substantially coincident with the corresponding portion of the circular outer end of the corresponding roller 50. The purpose of this construction will become apparent during the following description.

The inner end of each roller 50 is provided with a pinion 55 and each pair of pinions 55 meshes with one of the gears 47. It will be apparent that the axes of the rollers 50 are arranged radially with respect to the standard 12, and accordingly the axes of the pinions 55 of each pair are arranged at a slight angle with respect to each other. The pinions 55 are preferably spur gears, and each gear 47 is preferably slightly beveled to compensate for the slight angularity between the axes of the gears 55. The rollers 50 of each pair are adapted to support an article of glassware 56. Since the axes of the rollers 50 are horizontal and the rollers taper to decrease in diameter radially inwardly, it will be apparent that the glass articles will lie in an inclined position as shown in Figures 3, 4, 6 and 7.

The supporting of the ware in an inclined position causes it to tend to move radially inwardly with respect to the axis of the support 12, and means are provided for limiting the inward movement of the ware in adjusted positions in accordance with the desired length of the finished ware. Referring to Figures 3 and 7, it will be noted that each bearing 48 supports a supplemental bearing 57 thereabove, and this bearing is slightly tilted from the horizontal for a purpose to be described. A shaft 58 is mounted in each bearing 57 and

has a substantial portion of one end threaded as at 59. The shaft 58, including the threaded portion thereof, is slidable in the bearing 57 but is threaded in a bevel gear 60. Rotation of this gear, in a manner to be described, moves the shaft 58 axially with respect to the bearing 57, and the shaft is splined in the bearing as at 61 to prevent it from rotating with respect thereto.

Each shaft 58 is provided at its outer end with a stop member 62 having an outer face 63 arranged approximately at right angles to the axis of an article of glassware supported on the corresponding rollers 50. The face 63 limits the radially inward movement of the ware and thus positions it for the cracking off operation in accordance with the desired height at which the ware is to be cracked off. Each member 62 is adjustable radially with respect to the apparatus by being moved axially in its corresponding bearing 57, in a manner to be described, and the inclination of this bearing is such that the axis of the shaft 58 is approximately parallel to the axis of each article of glassware being cracked off.

Ordinarily, nothing more is necessary to support the ware in position other than the rollers 50 and stop members 62. An additional positioning device may be employed, however, in connection with ware which is relatively short so that it might be overbalanced by the cullets 64 left on the ware after the irons are broken off. Such additional positioning device may comprise a plate 65 secured to the stop member 62 by a bolt 66 having a wing nut 67, the stop member 62 being vertically slotted as at 68 (Figure 7) to permit vertical adjustment of the member 65. The latter member may be provided with downwardly diverging arms 69 adapted to receive the base portion of an article of glassware therebeneath when the apparatus is being used for cracking off ware which would be overbalanced by the weight of the cullets 64. Ordinarily the additional positioning member 65 may be omitted.

The shafts 58 are simultaneously rotated to adjust the stop members 62. The bevel pinions 60 mesh with a bevel gear 70 carried by a circular plate 71. As shown in Figure 4, the plate 71 has a hub portion 72 rotatably mounted on the standard 12 and supported on the plate 35 by a thrust bearing 73. It will be noted that the bevel-pinions 60 have their hub portions engaging the bearings 57 to prevent radially outward movement of the pinions 60. The inner extremities of these pinions engage an annular ring 74 carried by the plate 71, and accordingly radially inward movement of the pinions 60 is prevented.

A single operating handle is adapted to rotate the bevel gear 70 and thus simultaneously rotate all of the pinions 60 to adjust the stop members 62. Referring to Figures 1 and 2, the numeral 75 designates a bearing carried by and projecting upwardly above the plate 35 and rotatably supporting a shaft 76. At its radially inner end, the shaft 76 carries a bevel pinion 77 which is similar to the bevel pinions 60 and is arranged between a pair of the latter pinions. It will be noted that the pinion 77 also meshes with the gear 70, and the outer end of the shaft 76 carries a disk 78 provided with an operating handle 79 whereby the shaft 76 may be rotated to turn the bevel gear 70.

Inasmuch as all of the stop members 62 are simultaneously adjusted, a single scale may be provided for determining the positions of the stop members in accordance with the desired finished height of the glassware. Referring to Figure 2, it will be noted that one of the stop members 62, preferably adjacent the handle 79, is provided with a laterally extending pointer 80 operating over a scale 81 preferably calibrated in inches. The scale 81 may be supported above the plate 35 by suitable brackets 82. The turning of the handle 79 moves the indicating finger 80 along the scale 81, and all of the stop members will occupy the position indicated by the scale 81.

A horizontal ring 83 is arranged above and parallel to the plate 35 and is supported thereby through the medium of a plurality of circumferentially spaced posts 84. Accordingly it will be apparent that the ring 83 is supported for rotation with the plate 35. The ring 83 supports a plurality of burners which are employed in the cracking off operation.

Referring to Figures 2, 4 and 7, the numeral 85 designates a plurality of radially arranged bearings each having laterally extending wings 86 bolted against the upper face of the ring 83, as at 87. Each of the bearings 85 slidably and rotatably supports a shaft 88 upon the outer end of which is secured a burner support 89. Each burner support includes an inwardly extending sleeve 90 terminating in a ring 91 provided with a cam finger 92 corresponding in shape to and normally arranged in a cam recess 93 formed in the outer end of the associated bearing 85.

Each shaft 88 is provided inwardly of the bearing 85 with an arm 94 in the end of which is arranged a roller 95 for a purpose to be described. The arms 94 are normally arranged at an angle of approximately 45 degrees to the horizontal. Each arm 94 is provided with a hub portion 96 by which the arm is secured to the shaft 88, and a compression spring 97 is arranged between each hub 96 and the adjacent end of the corresponding bearing 85. The springs 97 urge the arms 94 radially inwardly, thus transmitting similar movement to the shafts 88 and burner supports 89. The cam finger 92 and cam recess 93 engage each other to swing the burner support to a normal position to be described, and upon turning movement of the arm 94 by means to be referred to the engagement of the cam elements moves each shaft 88 toward the left as viewed in Figure 3 and swings the burner support at an angle to its normal position.

Each burner support 89 is provided in its outer end with a recess 98 closed by a plate 99 to form a rectangular opening receiving a pipe 100 of rectangular cross-section. Each pipe 100 is arranged at a slight angle to the vertical, as shown in Figure 3, for a purpose to be described. A compressible gaseous mixture is supplied to each pipe 100 through a flexible hose 101 connected to each pipe 100 by an elbow 102.

The lower end of each pipe 100 is provided with a burner 103 which comprises a cast body having a manifold space 104 therein communicating with a series of small passages 105 which, in turn, communicate with larger openings 106 drilled into the lower face of the burner. A plug 107 is arranged in each of the openings 106 to break up the flow of gas into a series of small jets, the upper end of each opening 106 forming a small burner nozzle. These nozzles are arranged in a straight line and combine to provide a relatively long and narrow flame which is projected toward the glassware to heat the latter around a restricted zone as the ware is rotated by the

rollers 50. The burner 103 forms no part of the present invention per se and any suitable type of burner may be employed which is capable of projecting a flame of the character referred to. It is preferred, however, that a burner of the type referred to above be employed, such a burner being fully described and claimed in my copending application Serial No. 96,284, filed August 15, 1936.

The burner 103 and pipe 100 are arranged at a slight angle to the vertical as previously stated, and this arrangement is employed in order that the plane of the flame from the burner may be arranged at right angles to the closest point on the surface of the glassware. This arrangement limits the width of the heated zone of the ware. Moreover, the angular arrangement of the burner permits vertical adjustment of the latter without causing the flame to move longitudinally with respect to the glassware. It will be apparent, therefore, that upon adjustment of the position of the stops 62 for glassware of a given height, the burner may be adjusted up and down according to the diameter of the glassware without rendering the seating of the stop members 62 inaccurate. In other words, the axis of each pipe 100 is parallel to the outer face 63 of the associated stop member, and the distance between the flame of each burner and the bottom of the ware engaging the surface 63 will not vary regardless of the adjusted height of the burners.

Each burner is vertically adjusted by means of a screw shaft 108 having its lower end threaded in a boss 109 carried by the plate 99 (Figure 3). The shaft is rotatable in a boss 110 carried by a collar 111 secured to the corresponding pipe 100, collars 112 being secured to the shaft 108 on opposite sides of the lug 110 to prevent longitudinal movement of the shaft 108 with respect to the pipe 100. A handle 113 is connected to the upper end of each shaft 108 to facilitate rotation thereof.

Each flexible hose 101 is connected at its outer end to one of the elbows 102 (Figure 8) as previously stated, and the inner end of each hose is connected to an elbow 114 carried by the outer end of a radial pipe 115. Each hose 101, as shown in Figure 2, is curved into substantially semicircular form to provide an ample degree of flexibility between the ends of the hose to permit the burner assemblies to move with respect to the pipes 115 in a manner to be described. Each hose 104 may be provided with a conventional gas cock 116 to provide individual regulation of the gas supplied to each of the burners. The radially outer ends of the pipes 115 are supported by brackets 117 secured at their lower ends to the respective bearings 85, as shown in Figure 7.

Gas is supplied to the pipes 115 from a central manifold 118 supported by the standard 12 and rotatable with respect thereto. A stationary supply pipe 119 is arranged above the manifold 118 axially thereof and leads to a suitable supply of the combustible gaseous mixture employed for the burners. The manifold 118 is connected to a swivel 120 in which is arranged a body of packing 121 surrounding the machined lower end of the pipe 119. This packing provides a leak-proof joint between the pipe 119, which is stationary, and the manifold 118 which rotates with the burners and associated elements about the axis of the standard 12. A main cut off valve 122 is arranged in the pipe 119.

As previously stated, the burners are normally substantially vertical except for the slight inclination of these elements radially with respect to the standard 12. When in such position, each burner is adapted to heat a narrow zone of glassware during the rotation thereof, and means are provided for moving the burners out of normal position during a certain portion of the operation of the apparatus. Referring to Figures 2, 4, 7 and 8, the numeral 123 designates an arcuate cam track having its ends sloped downwardly as at 124 and 125, the trackway 123, throughout its length, being concentric with the standard 12. Upon the rotation of the burners, the rollers 95 contact with the inclined end 124 of the trackway, thus swinging the shafts 88 to turn the burner assemblies to the angular position shown in dotted lines in Figure 8 and at the right hand side of Figure 1. This turning movement also causes each cam finger 92 to ride on the inclined surface of the cam recess 93, thus moving the associated burner structure radially outwardly to the position shown in Figure 7. The trackway 123 is supported by the outer ends of radial arms 126, the inner ends of which are carried by a hub 127 secured to the standard 12 and accordingly fixed against movement with respect thereto.

A stone 128 is arranged at one side of the apparatus and is mounted to lightly contact with the glassware on the line heated by the burners, the stone being mounted slightly beyond the point at which the burners are turned and moved radially outwardly by the trackway 123. As the burners move past the stone 128, therefore, they will be arranged radially outwardly of the stone and accordingly the latter is not subjected to any heat from the burners. As will be explained below in connection with the present method, the stone is not essential in the apparatus, but its use greatly facilitates the operation of the apparatus and permits it to be operated at substantially higher speeds. Upon the initial light contacting of the stone 128 with the glassware, the cullet immediately cracks off and drops into a suitable collecting trough 129. The apparatus rotates in a clockwise direction as viewed in Figure 2, and the trough 129 extends counter-clockwise a substantial distance ahead of the point at which the ware contacts the stone 128, for a reason to be described.

The stone 128 is spring balanced in its normal position and is subject to adjustment vertically, and radially with respect to the standard 12. A post 130 is arranged radially outwardly of the trough 129, as clearly shown in Figure 7, and is secured at its lower end to a horizontal support 131 extending beneath and secured to the stationary plate 29. One end of the trough 129 also is secured to the support 130, and the other end of the trough is secured to the plate 29 by a suitable bracket 132 extending therebeneath.

The upper end of the post is slidable in a collar 133 having a horizontal platform 134 formed integral with its upper end. The collar 133 is adapted to be fixed in vertically adjusted positions with respect to the post 130 by means of a set screw 135, the mounting of the platform 134 and associated parts on the post 130 being clearly shown in Figure 9. At one side of the post 130 is arranged a threaded shaft 136 having its lower end threaded in a boss 137 carried by the post 130. The shaft extends upwardly through the platform 134 and is provided at its upper end with a hand wheel 138 having a hub 139 supported on the platform 134. A collar 140 is fixed to the shaft 136 and engages against the lower face

of the platform 134. Accordingly it will be apparent that the shaft 136 is fixed against vertical movement with respect to the platform 134 and associated elements to be described, and accordingly the platform 134 may be vertically adjusted upon the loosening of the thumb screw 135.

The platform 134 is provided with an upstanding flange 141 to which a horizontal support 142 has one edge pivotally connected as at 143. A pair of bolts 144 are secured at their lower ends to the platform 134 and extend upwardly through suitable openings in the support 142. Compression springs 145 surround the bolts 144 above and below the support 142 and are operative for spring-balancing the support in the normal position shown in Figures 1, 4, 7 and 9.

The support 142 is provided with a rectangular opening 146 through which extends a similarly shaped shank 147 adapted to be fixed against longitudinal movement in the opening 146 by a thumb screw or the like 148. The shank 147 has an integral stem portion 149 extending radially inwardly with respect to the apparatus as a whole and supports the stone 128, a nut 150 being employed for securing the stone in position on the stem 149. It will be apparent that the stone 128 does not rotate but whenever desired, the nut 150 may be loosened to turn the stone and thus present different portions of the edge thereof for contact with the glassware.

A stem 151 (Figure 7) is threaded in the outer end of the shank 147 and extends outwardly beyond the support 142. The outer end of the opening 146 is closed by a plate 152 through which the stem 151 extends, the outer end of the stem having an operating knob 153 engaging the outer face of the plate 152 to prevent axial movement of the stem 151 in one direction. The stem 151 also carries a collar 154 engaging the inner face of the plate 152 to prevent movement of the stem 151 in the other direction. Accordingly it will be apparent that upon the loosening of the thumb screw 148, the knob 153 may be rotated to adjust the position of the stone 128.

Automatic take off means are provided for the finished ware. Referring to Figures 1, 2 and 6, the numeral 155 designates a support similar to the support 131 and having its radially inner end bolted against the bottom of the plate 29. The outer end of the support 155 carries a pair of upstanding bearing brackets 156. A conveyor belt 157 passes around a roller 158 journaled between the upper ends of the posts 156, the upper run of the conveyor being operative for conveying glassware away from the apparatus after being fed to the conveyor in a manner to be described.

Each post 156 carries a pair of upstanding arms 159 between which is arranged a chute 160 which may be formed of any desired material. For example, the body of the chute may be formed of sheet metal 161 lined with a layer of felt or the like 162. The chute 160 curves downwardly and outwardly as shown in Figure 6, the upper end of the chute having its bottom portion arranged slightly below the level of the lowermost point of each article of glassware supported on the rollers 50. The lower end of the chute is substantially vertically arranged and approximately semi-circular in cross-section as indicated by the numeral 163 in Figure 2. Toward its upper end, the chute 160 increases substantially in width, the upper end of the chute having a substantially flat bottom 164 as shown in Figure 1. This increase in the width of the upper end of the chute is to insure the receiving of discharged glassware in the chute, as will become apparent.

A rod or arm 165 (Figures 5 and 6) extends angularly inwardly above the outer extremities of the rollers 50, the outer end of this rod extending downwardly for connection with one of the chute supports 159 as at 166 (Figure 1). It will be apparent that with the apparatus rotating in a clockwise direction, the successive articles, after being cracked off, will engage the arm 165 to be moved radially outwardly to and thus discharged into the chute 160 and guided to a vertical position to be supported on the conveyor 157.

The operation of the apparatus is as follows:

The motor 13 drives the conical pulleys 22 through the medium of the belt 20, and any desirable speed of operation may be obtained within the limits of the variations in the driving ratio provided by the variable speed transmission. If the handle 17 is rotated to move the motor 13 away from the shaft 23, the belt 20 will move the conical cones away from each other to engage these cones in a semi-circular line of reduced diameter. Under such conditions the shaft 23 will be driven at a relatively higher speed. Conversely, the handle 17 may be operated to move the motor 13 toward the shaft 23, in which case the arc of engagement of the belt 20 with the pulleys 22 will be increased, thus relatively reducing the speed of rotation of the shaft 23. As previously stated, the variable speed transmission per se forms no part of the present invention, but its use is desired, in order that the rate of production of the apparatus may be varied to any desired point within its limits.

Rotation of the shaft 23 drives the worm wheel 26 through the worm 25, thus driving the shaft 27 (Figures 1 and 4) and rotating the gear 33 through the pinion 37. The standard 12 is stationary and the plate 29 is secured to the standard and thus fixed against rotary movement. The plate 35 and gear 33 are fixed to the sleeve 32, and accordingly the gear 33 rotates the plate 35. Thus it will be apparent that the spindles 41 travel in an orbital path around the axis of the standard 12, and the spindles are rotated on their own axes through engagement of the pinions 42 with the gear 31.

Rotation of the spindles 41 drives the shafts 44 through the bevel gears 45 and 46, and since each gear 47 meshes with a pair of the pinions 55, it will be apparent that the rollers 50 will be constantly rotated on their own axes during rotation of the plate 35 about the axis of the standard 12. Both rollers of each pair will be rotated in the same direction. The operator may stand adjacent the apparatus just to the left of the chute 160 as viewed in Figure 2 and may feed successive articles of glassware to the rollers 50. These articles are in the form shown in Figure 3 with the cullets 64 thereon, and in placing the articles on the rollers the operator preferably will slide them along the rollers into engagement with the stop members 62. The operator may place an article upon each pair of approaching rollers 50, as will be apparent. As the plate 35 rotates about the axis of the standard 12, the bottom or radially inner ends of the articles will remain in contact with the faces 63 of the stop members due to the radial inclination of the top portions of the rollers 50 which support the articles. Thus the articles may be placed freely on the successive pairs of rollers and will remain in their correct positions without the use of any gripping means, as are now employed for rigidly fixing a glass article in

position during the etching operation. In this connection, it will be noted that with the present method and apparatus it is wholly unnecessary to etch a line around the article of glassware.

With articles of glassware of the general character shown in Figure 3, the hold-down members 69 are wholly unnecessary since the centers of gravity of the articles will be wholly inwardly of the outer ends of the rollers 50. In the case of very short articles which will be overbalanced by the substantial weights of the cullets 64 the members 69 may be adjusted to lightly engage the glassware to prevent the articles from being overbalanced by the cullets.

Attention is invited to the fact that at the point at which the articles are placed on the rollers 50, the adjacent burner will be arranged in inoperative position, that is, with the roller 95 (Figures 7 and 8) still in engagement with the horizontal portion of the trackway 123. The adjacent burner thus will be in the dotted line position shown in Figure 8, in which case the flame from the burner will be projected at a substantial angle away from the rollers which are being loaded. When the burner is in the inoperative position referred to, the cam finger will be turned with respect to the cam recess 93. After an article of glassware is placed on a pair of the rollers 50, the corresponding burner will return to normal position. As the roller 95 of such burner reaches the inclined end 125 of the trackway, the arm 94 is permitted to move downwardly and the corresponding compression spring 97 urges the corresponding shaft radially inwardly. The engagement of the inclined cam faces thus will swing the burner to its normal or substantially vertical position.

Slightly beyond the point at which the rollers are loaded, therefore, the burner will project a narrow flame directly against the glass article to heat a very narrow zone in the plane at which it is desired to crack off the glassware. The flame is projected substantially in the cracking off plane due to the inclination of the burner, as shown in Figure 3. During the projection of the burner flame against the ware, it will be apparent that the latter is being constantly rotated by its associated supporting rollers 50.

Each successive article of glassware will be rotated and subjected to the action of its associated burner in the same manner. The apparatus rotates in a clockwise direction as viewed in Figure 2, the narrow zone of heating of each article being raised to a progressively higher temperature during the rotation of the apparatus. As each article approaches the stone 128 it is ready to be subjected to the action of the latter to be cracked off in accordance with the preferred practice of the method through which the cracking off operations may be carried out at a relatively rapid rate as will be explained.

As each successive unit approaches the stone 128, the roller 95 of the associated burner supporting shaft 88 will engage the upwardly inclined end 124 of the trackway, and thus the shaft 88 will be swung to turn the burner to the angular position shown in dotted lines in Figure 8. At the same time, the turning operation of the shaft results in the axial movement thereof due to the engagement of the cam elements 92 and 93, and accordingly the burner will be moved outwardly to the position shown in Figure 7. Accordingly the flame from the burner will be projected wholly out of alignment with the stone 128, and when the burner passes the stone, the latter will not be subjected to the action of the burner and accordingly will remain cool. The heating of the narrow zone around the glass article in the manner referred to sets up internal stresses in the body of the glass around a shallow line and the glass will have a substantial tendency to crack off.

The cracking off operation will be initiated by the contact of the glass with the stone. In this connection it will be noted that the stone is spring balanced in such a position that the bottom extremity of the stone will lightly contact with the glass, no substantial pressure or abrasive action being necessary to cause the ware to crack off immediately upon its contact with the stone. Apparently the slight contraction of one point of the heated zone of the ware initiates the cracking off operation, which operation takes place immediately and perfectly upon light contact with the stone. The cullet drops into the trough 129 to be periodically collected therefrom.

After the cracking off operation has been completed, the continued rotation of the apparatus continues to move the finished article of glassware in a clockwise direction as viewed in Figure 2, and accordingly the bottom or radially inner end of the ware will be brought into contact with the bar 165 which is arranged just above the rollers 50 and in the angular position shown in Figure 2. As the apparatus rotates the bar 165 causes the glass article to be moved radially outwardly along the rollers until its center of gravity passes beyond the outer ends of the rollers whereupon the glass will tip over into the chute 160. The upper end of this chute is relatively wide in order to insure the reception of the article of glassware, the different articles being discharged at slightly different points in accordance with the specific distribution of weight in the different articles.

The upper ends of the brackets 53 (Figure 3) are curved as at 54 in the manner described to facilitate the discharging of the glass articles. If these elements were square at their upper ends, their contact with the radially moving article would tend to resist the sliding movement of the article, whereas the curving of the upper ends of the brackets 53 facilitates the entrance of the article into the chute 160. As the article is discharged through the chute 160, the vertical curvature of the latter guides the glassware to a vertical position, and the tapering of the chute toward its lower end guides the article laterally, if necessary, to position it centrally of the upper run of the conveyor belt 157. Thus this belt receives the successively discharged articles in a vertical position and conveys them to any desired collecting point.

From the foregoing it will be apparent that the present apparatus provides for the successive and continuous cracking off of glass articles and requires the use of only a single operator to feed the successive articles to the rollers 50. This is the only manual operation necessary, all other operations being carried out automatically, such as the moving of the burners to normal position, the rotating of the ware in the path of the burner flame, the moving of the burners to inoperative position, the positive cracking off of the ware, the collection of the cullets in the trough 129, and the discharging of the finished ware by the chute 160 to the take-off conveyor.

The apparatus also provides adjustments for taking care of various types and sizes of glassware. For example, the stop members 62 may be

quickly and accurately set according to the desired finished height of the glassware. To accomplish this, it merely is necessary for the operator to rotate the handle 79, whereupon the bevel pinion 77 will rotate the bevel gear 70, and thus impart simultaneous and equal rotation to the bevel pinions 60 (Figure 3). These pinions are fixed against axial movement and have threaded engagement with the threaded inner ends of the shafts 58. Rotation of each pinion 60, therefore, moves its associated shaft 58 axially to transmit similar movement to the corresponding stop member 62. As previously stated, one of these stop members is provided with a pointer 80 (Figure 2) operating over a scale 81 which is preferably calibrated in inches to indicate the height of the finished article. The setting of the pointer 80 will adjust all of the stop members 62 to exactly the same position, and accordingly it will be apparent that operation of the handle 79 serves to simultaneously adjust all of the stop members.

For articles of different diameters, the burners also may be adjusted with respect to the ware. This adjustment is very readily accomplished by turning the handles 113 (Figure 3) to rotate the threaded shafts 108 and thus adjust the height of the burners with respect to their supports 89. The vertical adjustment of the burners takes place in a plane parallel to the faces 63 of the corresponding stop members, and accordingly the burner adjustment does not affect the accuracy of the setting of the pointer 80 along the scale 81.

The stone 128 also may be readily adjusted in the manner previously described. Referring to Figures 1 and 9 it will be noted that vertical adjustment of the stone may be accomplished merely by loosening the thumb screw 135, turning the hand wheel 138, and then tightening the thumb screw 135. The stone is vertically adjusted to the proper position to cause it to lightly engage each successive article of glassware. Axial adjustment of the stone may be readily accomplished by loosening the thumb screw 148 (Figures 7 and 9), rotating the knob 153, and then tightening the thumb screw 148. Once this adjustment has been made, no further adjustment is necessary except in changing stones, between which there may be some slight variation. However, the wearing of the stone is negligible, and it rarely is necessary to replace the stone. It will be noted that the stone is provided with a relatively sharp edge which engages the glassware, and as wear takes place after a long period of use, the nut 150 may be loosened to permit the stone to be turned to a different position.

I have found that the cracking off of glassware may be accomplished without the necessity for rigidly supporting and rotating an article while etching a line therearound, and then cracking off the ware along the etched line. Such conventional method of procedure is extremely time consuming, and results in the conventionally slow production. The usual procedure, of course, involves the etching of the line around the glass and the momentary subjection of the glass to the action of a burner to crack off the ware around the etched line. I have discovered that the cracking off process may be practiced without the necessity of etching a line around the glass if the glass is heated throughout its circumference along a narrow line for a substantially longer period than glassware is now subjected to the momentary action of a cracking off burner. The apparatus described is particularly advantageous for practicing the method referred to.

The ware is supported on the rollers 50 and rotated thereby while the narrow flame from each burner heats a narrow zone completely around the ware. If this rotation of the ware and the heating thereof is carried out for several seconds during the rotation of the ware, the cracking off operation will take place without any other procedure. For example, in the present apparatus, if the supporting table 35 is rotated no more than approximately three revolutions per minute, the ware will crack off before it reaches the stone 128. With the present apparatus, therefore, approximately thirty-six glasses can be cracked off per minute, and this rate greatly exceeds the rate at which glassware can be cracked off at present by each operator. It has been found that the uniform heating of a narrow zone of the ware will cause it to crack off more nearly perfectly than can be done in accordance with conventional practice.

The use of the stone 128 is preferred in connection with the method and apparatus for the reason that it permits an even greater rate of production. If the supporting table 35 is rotated somewhat more rapidly than the rate indicated above, the cracking off of the ware usually will not take place before the ware reaches the stone 128, but the instant the stone contacts with the ware, the cracking off operation is initiated and instantaneously completed. At slightly more than three revolutions per minute, an occasional article will crack off shortly before reaching the stone 128, and the trough 129 accordingly is preferably elongated in the direction opposite to the direction of rotation of the apparatus in order to catch the occasional cullets which crack off ahead of the stone 128. At a greater speed of rotation of the apparatus, none of the ware will crack off under the influence of the heat from the burner, but the cracking off of the ware invariably occurs the instant the ware contacts with the stone 128. The use of the stone, therefore, permits the present apparatus to crack off from forty to seventy glasses per minute, depending upon the thickness of the ware.

Accordingly the present invention contemplates the provision of a method of cracking off glassware by heating the ware in a thin circumferential line. In order to provide a greater rate of production, the method also contemplates, in addition to the heating of the ware along a thin circumferential line, the contacting of the ware on the heated line by a relatively cool implement which need not necessarily be the stone described.

As previously stated, it is the common practice to grind the edges of glassware after the cracking off operation, and then to subject the edges of the ware to glazing burners to cause the edges to soften and run smooth. The same procedure may be followed in connection with ware cracked off in accordance with the present method. However, because of the fact that the present method and apparatus operate to provide a smoother cracked off edge than is provided with conventional methods, the ware need not be ground but may be glazed directly after it is taken from the cracking-off machine. The ware which has been glazed without grinding does not provide as perfect an edge as is desired for high class ware, but is uniformly almost perfect and provides a ware which is ample in quality for some purposes, as for example, for use in restaurants and the like. This type of glazed ware is more perfect in its results than ware which has been

glazed without grinding after being cracked off in accordance with conventional methods.

Accordingly it will be apparent that the present method and apparatus decrease the cost of production of tumblers and similar articles of glassware by greatly increasing the rate of production. Moreover, the method and apparatus make possible the production of a ware of good quality at a substantially lower cost through the elimination of the usual grinding operation.

It is to be understood that the form of the invention and the method herein described are to be taken as preferred examples of the same and that various changes in the practice of the method and in the size, shape and arrangement of parts may be made without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A cracking-off machine comprising a plurality of units each including a pair of substantially horizontal rollers for supporting an article of glassware and rotating it on its axis and a burner mounted to direct a relatively thin flame against the ware during rotation thereof to heat it along a thin circumferential line, common driving means for rotating said rollers on their axes and for successively moving said units past a predetermined loading point, and means for moving each burner to direct its flame in a different direction while the corresponding unit is passing said loading point.

2. A cracking-off machine comprising a plurality of units each including a pair of substantially horizontal rollers for supporting an article of glassware and rotating it on its axis and a burner mounted to direct a relatively thin flame against the ware during rotation thereof to heat it along a thin circumferential line, common driving means for rotating said rollers on their axes and for successively moving said units past a predetermined loading point, means for moving each burner to direct its flame in a different direction while the corresponding unit is passing said loading point, and a relatively stationary implement arranged a predetermined distance from said loading point and positioned to contact each successive article on its circumferentially heated line.

3. A cracking-off machine comprising a pair of adjacent elongated rollers forming the sole means for supporting an article of glassware and rotating it on its axis, the portions of said rollers contacting with the article being inclined slightly from the horizontal to tend to move the ware in one direction longitudinally of the rollers, means for limiting the movement of the ware in such direction, a burner for directing a thin flame against the ware during rotation thereof to heat it along a thin circumferential line, means for bodily moving said rollers and said burner, and an implement mounted adjacent the path of bodily movement of said burner and arranged to contact with the article on its circumferentially heated line.

4. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers arranged substantially radially with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware and having the portions of such rollers in contact with the article sloping downwardly radially inwardly with respect to said table, means for limiting the radially inward movement of an article supported by each pair of rollers, and a plurality of burners mounted for rotation with said table and each arranged for directing a thin flame against an article on one pair of rollers radially outwardly thereof.

5. A cracking-off machine comprising a pair of adjacent elongated rollers forming the sole means for supporting an article of glassware and rotating it on its axis, the portions of said rollers contacting with the article being inclined slightly from the horizontal to tend to move the ware in one direction longitudinally of the rollers, means for limiting the movement of the ware in such direction, a burner for directing a thin flame against the ware during rotation thereof to heat it along a thin circumferential line, means for bodily moving said rollers and said burner past a predetermined loading point, and means operative for directing the flame from the burner in a different direction while passing said loading point.

6. A cracking-off machine comprising a pair of adjacent elongated rollers forming the sole means for supporting an article of glassware and rotating it on its axis, the portions of said rollers contacting with the article being inclined slightly from the horizontal to tend to move the ware in one direction longitudinally of the rollers, means for limiting the movement of the ware in such direction, a burner for directing a thin flame against the ware during rotation thereof to heat it along a thin circumferential line, means for bodily moving said rollers and said burner past a predetermined loading point, means operative for directing the flame from the burner in a different direction while passing said loading point and an implement arranged at a point spaced from said loading point and positioned to contact with the ware on its circumferentially heated line.

7. A cracking-off machine comprising a plurality of units each including a pair of rollers for supporting an article of glassware for rotation on its axis, said rollers being slightly inclined from the horizontal to tend to move the ware in one direction longitudinally with respect to said rollers, a stop member for limiting movement of the ware in such direction, and a burner for directing a narrow flame against the ware during rotation thereof to heat it along a thin circumferential line, and common means for simultaneously adjusting said stop members.

8. A cracking-off machine comprising a plurality of units each including a pair of rollers for supporting an article of glassware for rotation on its axis, said rollers being slightly inclined from the horizontal to tend to move the ware in one direction longitudinally with respect to said rollers, a stop member for limiting movement of the ware in such direction, and a burner for directing a narrow flame against the ware during rotation thereof to heat it along a thin circumferential line, common means for simultaneously adjusting said stop members, means for successively moving said units past a predetermined loading point, and automatic means for directing the flame of each burner away from the ware as it passes said loading point.

9. A cracking-off machine comprising a plurality of units each including a pair of rollers for supporting an article of glassware for rotation on its axis, said rollers being slightly inclined from the horizontal to tend to move the ware in one direction longitudinally with respect to said rollers, a stop member for limiting movement of the ware in such direction, and burn-

er for directing a narrow flame against the ware during rotation thereof to heat it along a thin circumferential line, common means for simultaneously adjusting said stop members, and an implement engageable with each article on its circumferentially heated line after the flame of the burner has been directed against the ware for a predetermined length of time.

10. A cracking-off machine comprising a plurality of units each including a pair of rollers for supporting an article of glassware for rotation on its axis, said rollers being slightly inclined from the horizontal to tend to move the ware in one direction longitudinally with respect to said rollers, a stop member for limiting movement of the ware in such direction, and a burner for directing a narrow flame against the ware during rotation thereof to heat it along a thin circumferential line, common means for simultaneously adjusting said stop members, means for successively moving said units past a predetermined loading point, automatic means for directing the flame of each burner away from the ware as it passes said loading point, and an implement arranged a predetermined distance from said loading point and positioned to engage each successive article on its circumferentially heated line.

11. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers arranged substantially radially with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware and having the portions of such rollers in contact with the article sloping downwardly radially inwardly with respect to said table, means for limiting the radially inward movement of an article supported by each pair of rollers, a plurality of burners mounted for rotation with said table and each arranged for directing a thin flame against an article on one pair of rollers radially outwardly thereof, and a relatively stationary implement mounted adjacent the path of circular movement of the articles incident to rotation of said table and arranged to contact each successive article on its circumferentially heated line.

12. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers arranged substantially radially with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware and having the portions of such rollers in contact with the article sloping downwardly radially inwardly with respect to said table, means for limiting the radially inward movement of an article supported by each pair of rollers, and burner means for continuously heating the articles supported on the rollers during a substantial portion of the rotational movement of said table.

13. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers arranged substantially radially with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware and having the portions of such rollers in contact with the article sloping downwardly radially inwardly with respect to said table, means for limiting the radially inward movement of an article supported by each pair of rollers, burner means for continuously heating the articles supported on the rollers during a substantial portion of the rotational movement of said table, and an implement mounted adjacent the path of circular movement of the articles incident to rotation of said table and arranged to contact with the successive articles on their circumferentially heated lines.

14. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers having their axes substantially horizontal and arranged substantially radially with respect to said table, each roller being tapered to increase in size radially outwardly with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware, means arranged to contact with the article on each pair of rollers to limit movement of the article radially inwardly with respect to said table, and a burner arranged with respect to each pair of rollers for directing a thin flame against an article supported thereon.

15. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers having their axes substantially horizontal and arranged substantially radially with respect to said table, each roller being tapered to increase in size radially outwardly with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware, means arranged to contact with the article on each pair of rollers to limit movement of the article radially inwardly with respect to said table, a pinion carried by one roller of each pair, means for simultaneously driving said pinions to rotate each article of glassware on its axis, and a burner arranged with respect to each pair of rollers for directing a thin flame against an article supported thereon.

16. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers having their axes substantially horizontal and arranged substantially radially with respect to said table, each roller being tapered to increase in size radially outwardly with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware, means arranged to contact with the article on each pair of rollers to limit movement of the article radially inwardly with respect to said table, a burner associated with each pair of rollers and normally directing a thin flame against an article supported thereon, means for supporting each burner for rocking movement on a substantially horizontal axis, and means operative during a portion of the rotation of said table for turning each burner on its axis to direct the flame away from the article of glassware.

17. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers having their axes substantially horizontal and arranged substantially radially with respect to said table, each roller being tapered to increase in size radially outwardly with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware, means arranged to contact with the article on each pair of rollers to limit movement of the article radially inwardly with respect to said table, a burner associated with each pair of rollers and normally directing a thin flame against an article supported thereon, means for supporting each burner for rocking and sliding movement on a substantially horizontal axis arranged substantially radially with respect to said table, and means operative during a portion of the rotation of said table for rocking each burner on its axis and for sliding it radially outwardly with respect to said table to direct the flame away from the adjacent article of glassware.

18. A cracking-off machine comprising a rotatable table, a plurality of pairs of adjacent elongated rollers having their axes substantially horizontal and arranged substantially radially with respect to said table, each roller being tapered to increase in size radially outwardly with respect to said table, each pair of rollers forming the sole means for supporting an article of glassware, a stop element engageable with an article of glassware on each pair of rollers for limiting movement of the article radially inwardly with respect to said table, a threaded stem carried by each stop element and projecting radially inwardly with respect to said table, means for supporting each stem for axial sliding movement, a pinion threaded on each stem, a ring gear engaging all of said pinions to rotate them simultaneously, and a burner mounted to direct a thin flame against an article of glassware on each pair of rollers.

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