Sept. 16, 1930. A. L. BROWN 1,776,143

POLISHING MACHINE

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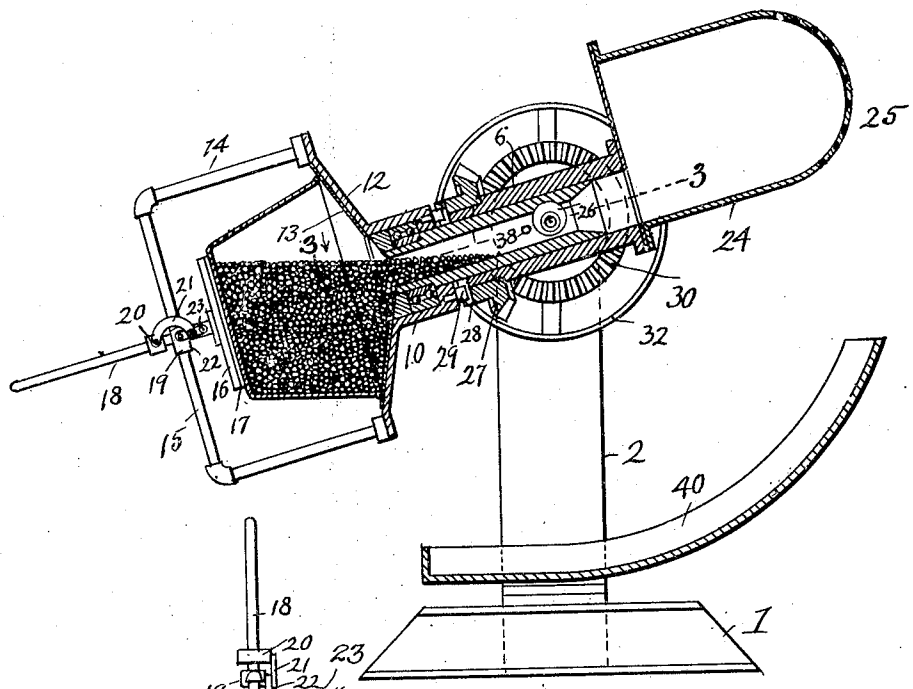


Fig. 1.

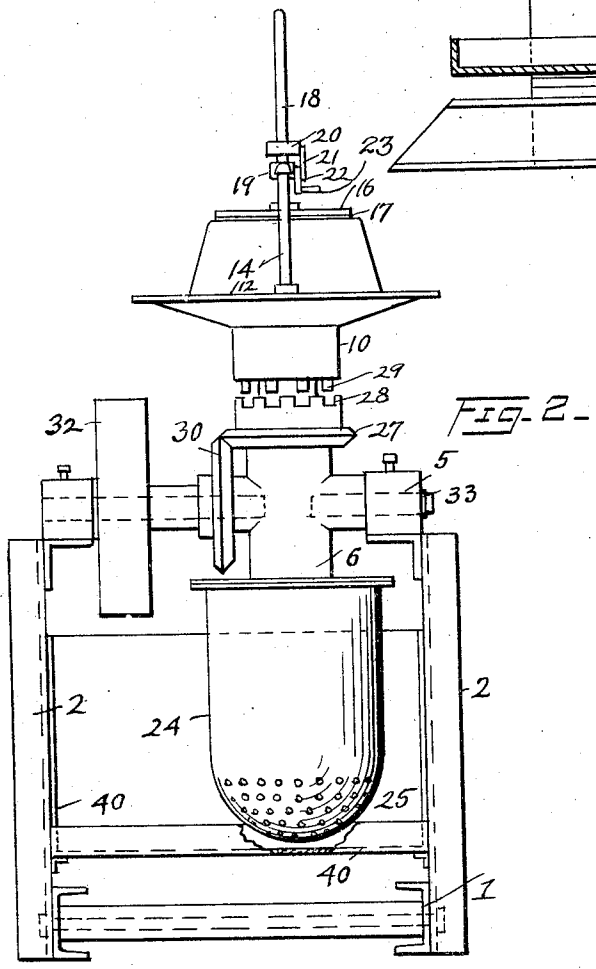


Fig. 2.

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FIG. 4.

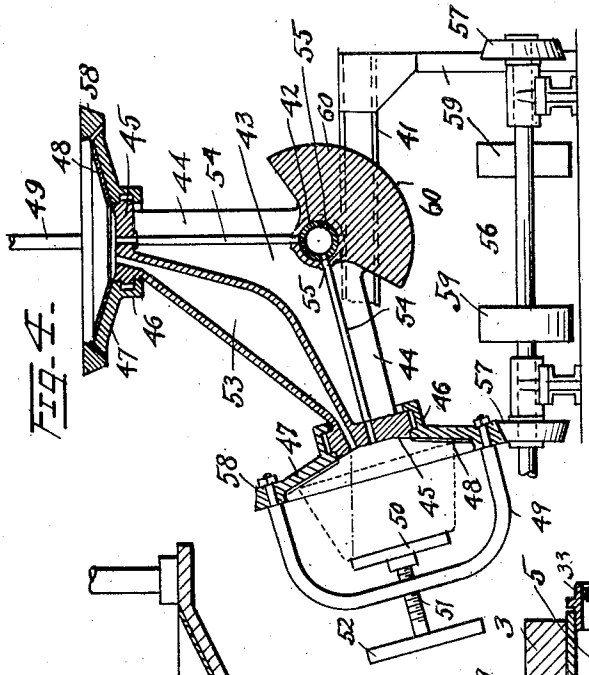


FIG. 5.

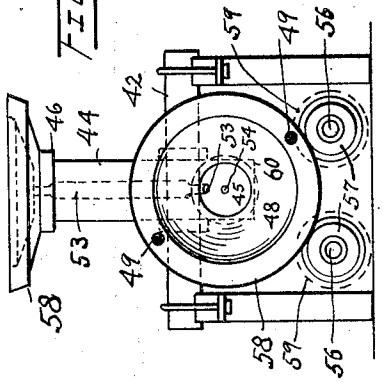
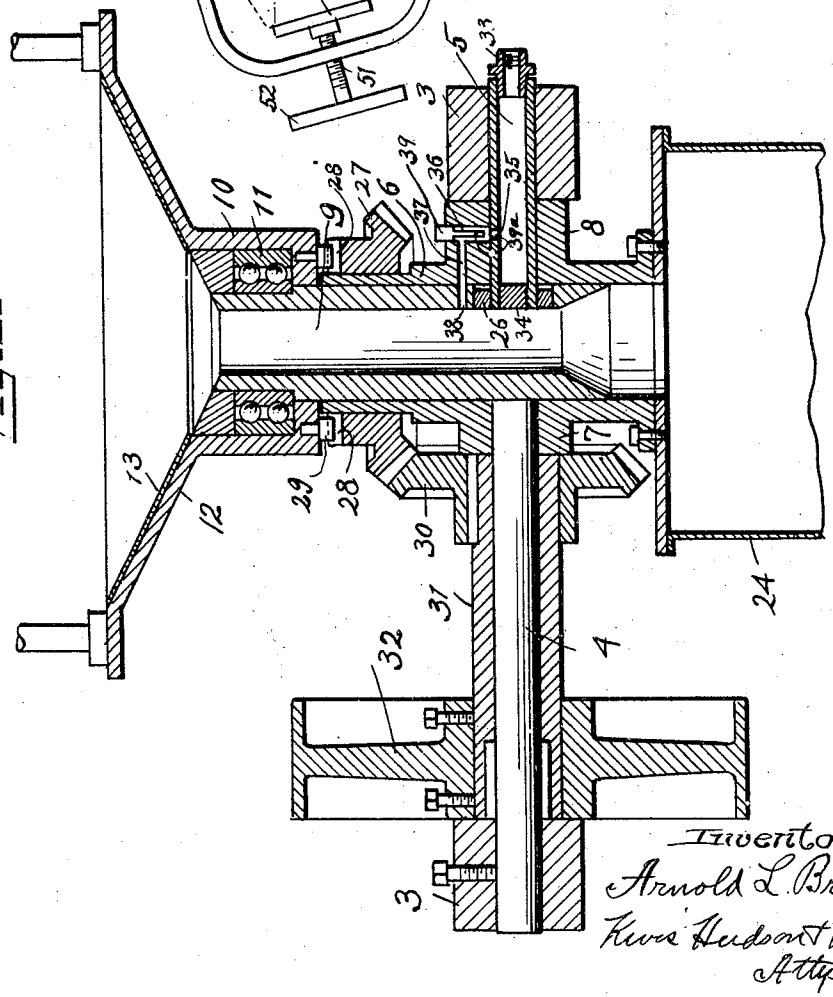


FIG. 3.



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Fig. 6.

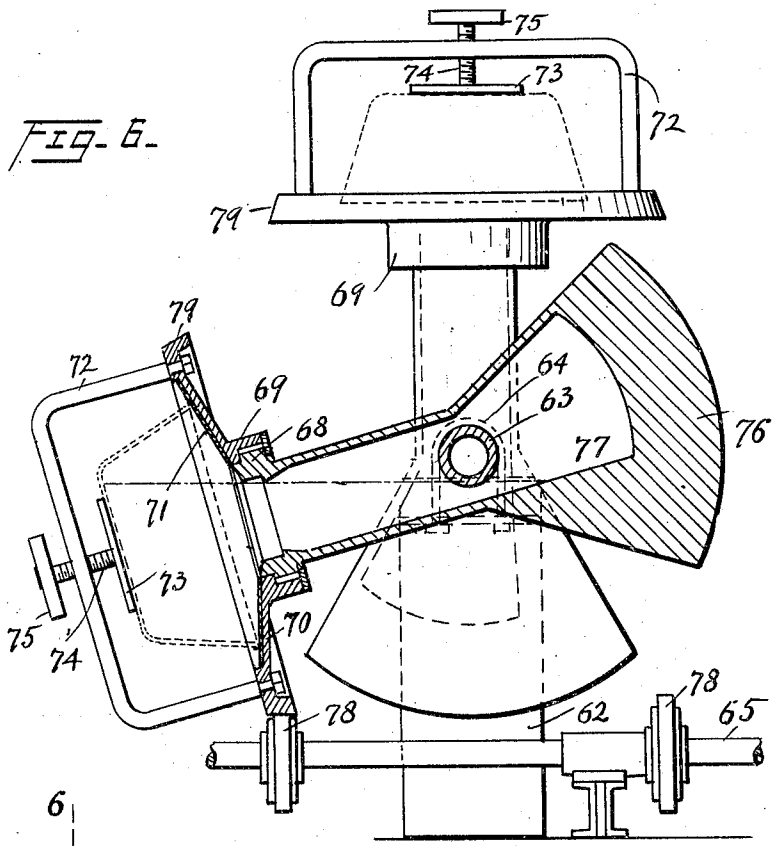
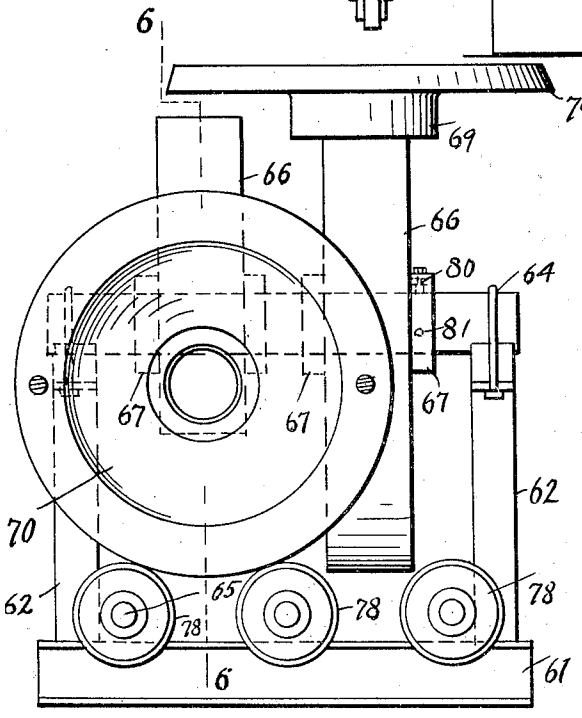


Fig. 7.



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FIG. 8.

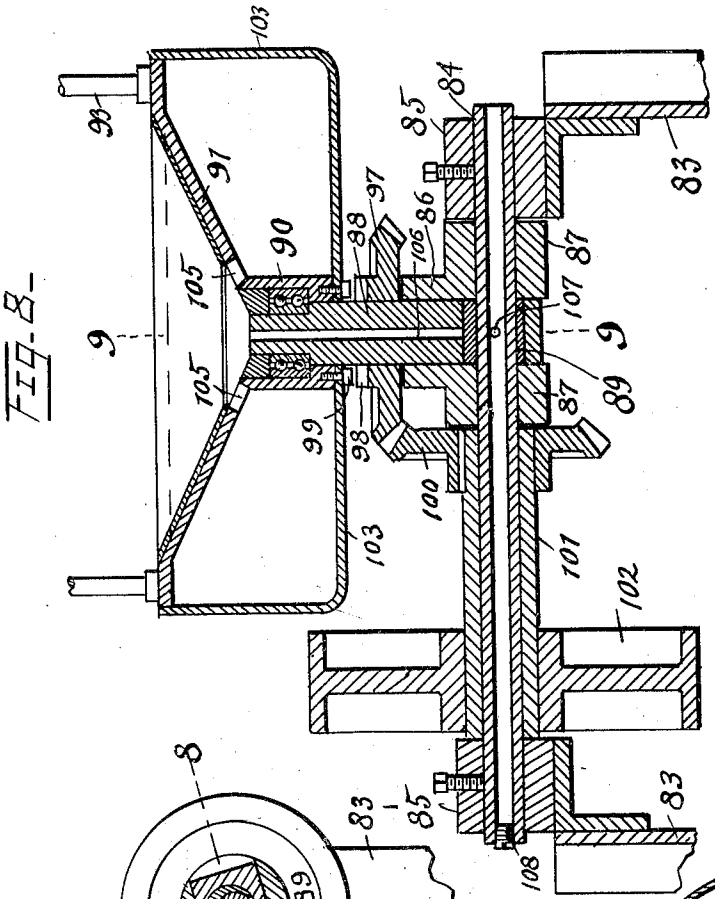


FIG. 9.

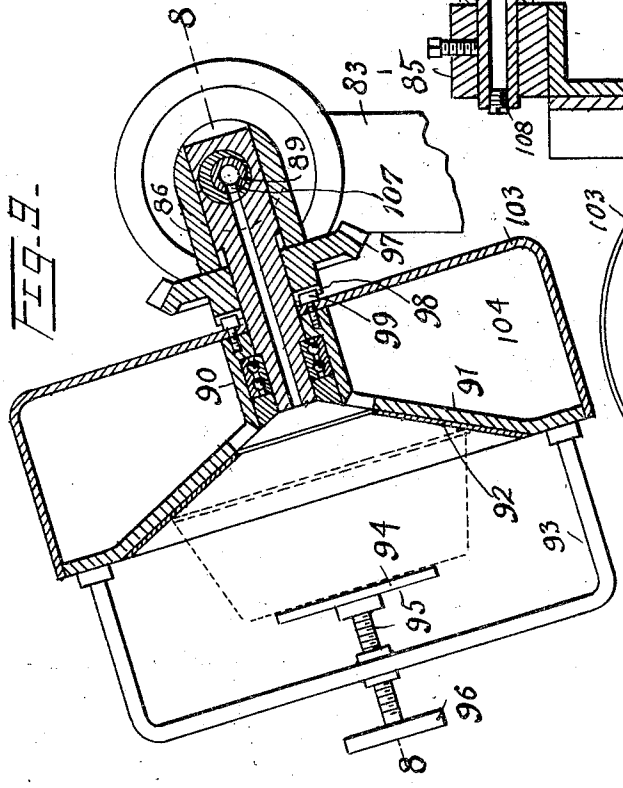
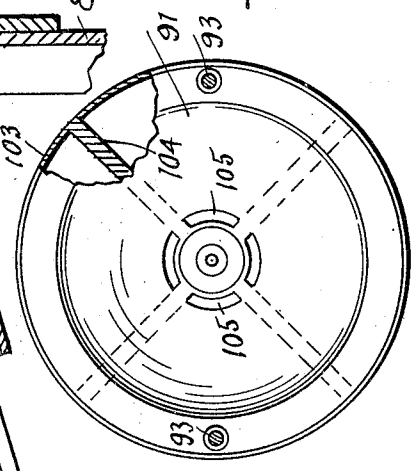


FIG. 10.



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UNITED STATES PATENT OFFICE

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POLISHING MACHINE

Application filed November 12, 1926. Serial No. 147,967.

This invention relates to a polishing machine of the type in which a mass of solid polishing material is maintained in contact with a rotating surface to polish the same, the invention being particularly applicable to the polishing and hardening of the interior surface of metal hollow-ware articles, such as aluminum cooking utensils.

The principal objects of the present invention are to provide a machine in which the solid mass of polishing material is caused to act upon the surface to be polished in a manner such that the polishing action is more effective and to provide a machine in which the handling of the articles to be polished and of the polishing material is facilitated.

The invention has for a further object to provide a machine in which a rotatable chuck is provided for holding the article to be polished with a mass of polishing material in contact with the surface thereof in which means is provided in connection with the chuck for retaining the polishing material while an article is being removed from the chuck and another article is being placed therein.

A further object is to provide a movable mounting for the chuck permitting the same to be moved from an inoperative loading position to an operative position together with driving means which is automatically connected with the chuck when it is moved to operative position and disconnected therefrom when the chuck is moved away from operative position.

A further object is to provide means in connection with the movably mounted chuck for automatically applying the polishing material to the article when the chuck is moved to operative position.

A further object is to provide a movably mounted chuck adapted to hold an article to be polished and to form with the article a chamber for confining a mass of balls in contact with the surface of the article and to provide, in connection with the chuck, devices for automatically supplying a cleansing solution to the chamber containing the balls when the chuck is in operative position.

With the above and other objects in view the invention may be said to comprise the machine as illustrated in the accompanying drawings hereinafter described and particularly set forth in the appended claims together with such variations and modifications thereof as will be apparent to one skilled in the art to which the invention appertains.

Reference should be had to the accompanying drawings forming a part of the specification in which:

Figs. 1, 2 and 3 show the embodiment of the invention which at the present time is the preferred form thereof, Fig. 1 being a vertical central section taken axially through the article supporting chuck, Fig. 2 being a front elevation of the machine and Fig. 3 being a fragmentary section on an enlarged scale taken on the line indicated at 3—3 in Fig. 1.

Figs. 4 and 5 show a modified embodiment of the invention, Fig. 4 being a central vertical section and Fig. 5 being a front elevation of the machine.

Figs. 6 and 7 show a further modification of the invention, Fig. 6 being a vertical section taken on the line indicated at 6—6 in Fig. 7 and Fig. 7 being a front elevation of the machine.

Figs. 8, 9 and 10 show a further modification of the invention, Fig. 8 being a section indicated on the line 8—8 in Fig. 9, Fig. 9 being a section on the line indicated at 9—9 in Fig. 8 and Fig. 10 being a plan view of the face of the chuck.

Referring to Figs. 1, 2 and 3 of the drawing the machine is provided with a supporting frame having a base 1 and standards 2 at opposite ends of the base. Upon the upper ends of the standards 2 there are coaxial bearing members 3 in one of which is fixed an inwardly projecting shaft 4 and in the other of which there is fixed an inwardly projecting tubular shaft 5. The inner ends of the coaxial shafts 4 and 5 are spaced a short distance apart and rotatably mounted upon these shafts there is a tubular supporting member 6 which has laterally projecting bearing bosses 7 and 8 which receive the shafts 4 and 5. The hollow tubular supporting member 6 extends at right angles to the axis of the shafts 4 and 5 and within this

supporting member there is a sleeve 9 which projects beyond the supporting member at one end and has a sliding fit within the supporting member. Upon the outer end of the tubular member 9 there is rotatably mounted a chuck 10, a ball bearing 11 being interposed between the hub of the chuck and the outer end of the member 9.

The chuck 10 has an article receiving portion 12 provided with a recessed conical face upon which there may be secured a rubber facing 13. The chuck 10 carries a clamp supporting frame which consists of posts 14 rigidly secured at their inner ends to the rim of the chuck at diametrically opposite points and a cross bar 15 connecting the outer ends of the posts 14. A clamping member 16 is adjustably mounted upon the supporting frame and is preferably provided with a rubber facing 17 for engagement with the bottom of a hollow-ware article to be clamped against the face of the chuck. The clamping member 16 is carried by a rod 18 which is slidably mounted in a bearing member 19 at the center of the cross bar 15. The rod 18 has a collar 20 fixed thereto outside the bearing 19 and this collar is connected to the bearing 19 by means of a toggle connection consisting of a curved link 21 pivoted at its outer end to the collar 20 and a straight link 22 pivoted at one end to the bearing member 19 and intermediate its ends to the inner end of the link 21. The free end of the link 22 projects beyond the pivot connecting the two links of the toggle and has attached thereto a laterally projecting handle 23 by means of which the links may be shifted to position the pivot connecting links in either of their dead center positions i. e., either between the bearing member 19 and the clamping member 16 for holding the clamping member in clamping position or between the collar 20 and bearing member 19 to hold the clamping member in releasing position.

The tubular supporting member 6 projects to the side of the pivotal axis opposite that on which the chuck is mounted and has attached thereto a receptacle 24 adapted to contain a mass of polishing material, preferably small steel balls of various sizes. As shown in Fig. 1 a hollow-ware article may be clamped in the chuck with its open end bearing against the conical face of the chuck so that the chuck forms with the article held therein a chamber in which a mass of balls may be confined in engagement with the interior surfaces of a hollow-ware article. The receptacle 24 is in communication with the chamber formed by the hollow-ware article and the face of the chuck through the tubular members 6 and 9 so that when the chuck is moved to the position shown in Fig. 1 below the level of the receptacle 24 the balls will pass by gravity from the receptacle 24 to the interior of the hollow article and when the supporting member is moved to vertical position, as shown in Fig. 2, the balls will pass from the interior of the hollow article into the receptacle 24. A cleansing liquid is preferably supplied to the interior of the hollow article and the outer end portion 25 of the receptacle 24 is provided with small perforations to permit the cleansing liquid to drain from the receptacle.

The inner end of the hollow shaft 5 projects through the wall of the supporting member 6 and has fixed thereto, inside the member 6, an eccentric 26 which fits in a round opening in the wall of the inner tubular member 9. The movement of the supporting member 6 about its pivotal axis will cause the inner tubular member 9 to turn upon the fixed eccentric 26 and move inwardly and outwardly with respect to the member 6. Upon the end of the supporting member 6 adjacent the chuck 10 there is rotatably mounted a bevel gear 27 which has on its outer face clutch teeth 28 which are adapted to engage with clutch teeth 29 upon the inner end of the chuck. The supporting member 6 is movable from the vertical position shown in Fig. 2 to the downwardly inclined position shown in Fig. 1. When in the vertical position the chuck supporting member 9 is held by the fixed eccentric 26 in its uppermost position with respect to the supporting member 6 so that the clutch teeth 29 are held out of engagement with the clutch teeth 28 of the bevel gear 27. When the chuck supporting end of the supporting member is moved downwardly past horizontal position the fixed eccentric 26 will have retracted the chuck carrying member 9 sufficiently to bring the clutch teeth 28 into engagement with the clutch teeth 29 of the bevel gear and the downward movement of the chuck and its supporting member is limited by the eccentric 26 since, when the inner end of the chuck is brought into engagement with the outer end of the supporting member 6, further turning movement on the eccentric 26 is prevented. The bevel gear 27 is driven by a bevel gear 30 fixed to a sleeve 31 which is rotatably mounted on the shaft 4 and has fixed thereto a belt pulley 32 by which the machine is driven.

A mass of small steel balls of different sizes is placed within the receptacle 24 and these balls, when the receptacle is in vertical position as shown in Fig. 2, serve to bring the center of gravity of the connected chuck, supporting member and receptacle well below the pivotal axis so that they are retained by gravity in vertical position. When the chuck is in vertical position a hollow-ware article is clamped against the face of the chuck and the operator by grasping the rod 18 pulls the chuck over toward the operative position shown in Fig. 1. As the chuck moves downwardly the balls begin to roll from the receptacle 24 into the hollow receptacle held by

the chuck so that as the chuck approaches its lowermost position the center of gravity is shifted to the side of the axis upon which the chuck is located and the weight of the balls thus serve to positively hold the chuck in its operative position. The downward movement of the chuck automatically clutches the chuck to the gear 27 so that the chuck and article carried thereby are rotated.

Means is also provided for supplying a cleansing liquid to the interior of the receptacle during the polishing operation, the cleansing liquid being introduced through the hollow shaft 5 which has a nipple 33 at its outer end by which it may be connected to a conduit for supplying the cleansing liquid which is preferably a hot soap solution. The inner end of the hollow shaft 5 is closed by a plug 34 and intermediate at its ends the hollow shaft 5 has a lateral opening 35 which opens into a radial passage 36 in the boss 8 of the supporting member. A lateral passage 37 extends from the radial passage 36 to the interior of the hollow supporting member 6 and this passage is adapted to register with an opening 38 in the inner hollow chuck supporting member 9. The outer end of the radial passage 36 is closed by a plug 39 which has a stem 39a projecting past the lateral passage 37 to prevent entry of balls into the passage 36. The lateral opening 35 in the tubular shaft 5 is so positioned that it registers with the radial passage 36 when the supporting member is in chuck operating position, as shown in Fig. 1, and the opening 38 is so positioned in the wall of the tubular member 9 that it registers with the lateral passage 37 when the chuck is brought to operative position. It will thus be apparent that the cleansing liquid under pressure in the tubular shaft 5 will pass through the opening 35, passages 36 and 37 and opening 38 into the interior of the tubular member 9 and thence into the mass of balls within the hollow-ware article being polished while the chuck is being rotated and that as soon as the chuck has moved away from operating position the flow of cleansing fluid will automatically be cut off. During the polishing operation the cleansing fluid will back up through the axial passage leading from the chuck to the receptacle 24 and will drain through the perforations in the end 25 of the receptacle. A drip catching trough 40 is preferably provided beneath the receptacle 24 to catch the drippings and the cleansing fluid thus collected may be reclaimed by passing through a suitable heating and filtering system.

In the operation of the machine an article is placed in the chuck while the chuck is held in vertical position and the chuck is then swung downwardly to the position shown in Fig. 1 causing the chuck to be automatically clutched to the gear 27 whereupon the chuck will be rapidly rotated by the driving mechanism. At the same time the passages for delivering cleansing fluid to the interior of the articles are automatically opened and the cleansing fluid is continuously supplied during the cleansing operation. After the chuck and article carried thereby have been rotated for a sufficient length of time the operator swings the chuck up out of operative position by means of the rod 18 automatically disconnecting the clutch from its driving mechanism and causing the balls to roll from the interior of the article into the receptacle 24 shifting the center of gravity to the side of the pivotal axis opposite to that upon which the chuck is located so that after the chuck has been moved upwardly a short distance it will be automatically moved by the weight of the balls to its vertical position. When the chuck is in its vertical inoperative position the polished article can be removed from the chuck and replaced by an article to be polished.

Referring to the modifications shown in Figs. 4 and 5 of the drawings a suitable supporting frame 41 supports a tubular horizontal shaft 42 upon which is pivoted a chuck supporting member 43 which has a pair of arms 44 extending radially at an angle to each other slightly greater than 90°. Each of the arms 44 has an enlarged bearing head 45 at its outer end and upon each of these heads there is rotatably mounted a chuck 46. The chuck 46 has an article receiving portion 47 which has a conical recessed outer face preferably provided with a rubber covering 48 against which the rim of a hollow-ware article is clamped.

For clamping an article to the chuck each chuck is provided with a rigid U-shaped bar 49 which is rigidly secured at its ends to the rim portion of the chuck at diametrically opposite points thereon. The bar 49 serves to support a clamping member 50 which is carried by a rod 51 which has a threaded engagement with the bar 49 axially of the chuck and which is adapted to be turned by means of a hand wheel 52 to force the member 50 into clamping engagement with the bottom of a hollow-ware article.

The two heads 45 are connected by a diagonally dosposed ball passageway 53 which extends through each of the heads so that balls may pass to the interior of a hollow-ware article supported on either of the chucks.

Each of the arms 44 is provided with an axial passageway extending from the opening through which the shaft 42 extends through the head 45 for admitting cleansing fluid to the interior of an article being polished. The tubular shaft 42 is provided with two openings 55 at angularly spaced points adapted to alternately register with the passageways 54 as the chucks to which the passageways lead are brought to operative position.

Adjacent the bottom of the supporting frame 41 two parallel shafts 56 are mounted which extend at right angles to the shaft 42 and which lie upon opposite sides of the supporting member 43. At opposite sides of the frame the shafts 56 have bevel friction wheels 57 which are arranged to engage with bevel edges 58 of the two chucks, one of the chucks resting upon the pair of wheels 57 at one side of the frame when in operative position and the other chuck being engageable with the corresponding pair of friction wheels at the opposite side of the frame. The shafts 56 may be driven by means of suitable belt pulleys 59 so that the chuck which is resting upon one of the pairs of friction wheels 57 will be driven. As shown in Fig. 4, one of the chucks is in vertical position while the other of the chucks is in operative position in engagement with the pair of wheels 57 at the left-hand side of the frame 41. When the chuck shown at the left in Fig. 4 is lifted the other chuck is moved downwardly toward the opposite side of the frame and when the first mentioned chuck reaches vertical position the other chuck will be brought into engagement with the friction wheels 57 at the right-hand side of the frame.

In the operation of the machine the hollow-ware article is clamped with its open end against the face of a chuck while the chuck is in its uppermost or inoperative position the chuck with the hollow-ware article clamped thereto will then be moved downwardly into engagment with its driving wheels bringing the other chuck to its uppermost or vertical position. A suitable quantity of small steel balls may be introduced into the recessed face of the uppermost chuck and these balls will pass through the passageway 53 into the interior of the hollow article carried by the lower chuck. While the first chuck is being rotated a hollow-ware article may be clamped upon the idle chuck and after the operation upon the first article is completed the support 43 will be rocked to bring the second chuck into engagement with its driving wheels whereupon the balls will pass from the first chuck to the second through the passageway 53, the balls being automatically transferred to the interior of a hollow-ware article on a chuck whenever the chuck is moved to its operative position. To facilitate the movement of the supporting member 43 about its pivotal axis a counterweight 60 may be provided which will reduce the initial lifting force required for raising the chuck off of its driving wheels. As in the modification first described the balls are shifted from one side to the other of the pivotal axis during movements of the supporting member and serve to maintain the chucks in their operative positions. Cleansing fluid under pressure is supplied to the tubular shaft 42 and the openings 55 in the shaft are so positioned that they alternately register with the passages 54 as the chucks are brought into engagement with their driving wheels.

Referring to the modification shown in Figs. 6 and 7 the machine is provided with a suitable supporting frame which has a base 61 and vertical standards 62 at opposite ends thereof which support at their upper ends a tubular shaft 63 which is rigidly clamped to the standards by suitable U-bolts. 64. Upon the base of the frame there are mounted a series of spaced shafts 65 which extend at right angles to the tubular shaft 63 and pivotally mounted upon the shaft 63 at points intermediate successive shafts 65 on the base are a plurality of chuck supporting members 66 which are of tubular form and are provided with laterally projecting bosses 67 through which the shaft 63 extends. Each of the supporting members 66 is pivoted intermediate its ends to the shaft 63 and has at one end an enlarged bearing head 68 upon which is rotatably mounted a chuck 69.

Each chuck 69 is provided with an article receiving portion 70 which has a conical recessed outer face provided with a rubber covering 71 against which the rib of a hollow-ware article may be clamped. For clamping the articles to the chucks each chuck has attached thereto a U-shaped bar 72 which has its opposite ends rigidly secured to the rim portion of the chuck at diametrically opposite points. The U-shaped bar 72 supports a clamping member 73 which is carried by a rod 74 threaded in bar 72 axially of the chuck and which is provided with a hand wheel 75 at its outer end by means of which the clamping member may be forced against the bottom of a hollow-ware article to clamp the same to the chuck.

The end of each supporting member 66 opposite that upon which the chuck is mounted is formed to provide a counterweight 76 and is hollow to provide a ball receiving chamber 77 opening through the head 68 and extending into the counterweight 76.

At each side of the frame the shafts 65 are provided with longitudinally aligned friction driving wheels 78 upon which the beveled edges 79 of the chucks are adapted to rest, each chuck engaging with a pair of wheels on adjacent shafts.

The counterweight 76 together with the balls in the chamber 77 serves to bring the center of gravity of the supporting member beneath the pivot shaft 63 when the supporting member is in vertical position so that a chuck will be held in vertical position by gravity after it has been swung upwardly by the operator. When a chuck is pulled downwardly by the operator the balls will roll from the chamber 77 into the interior of a hollow article clamped to the

chuck shifting the center of gravity to the side of the axis upon which the chuck is mounted so that the chuck is held by gravity in engagement with its driving wheels 78.

Cleansing fluid is automatically supplied to the interior of the article during the polishing operation through the tubular shaft 63 and through passages 80 in the bosses 67 which register with apertures 81 in the tubular shaft 63 when the supporting member is moved to a position in which its chuck engages with the driving wheels. While one chuck is in its operative position the adjacent chuck is held in its inoperative vertical position so that a finished article can be replaced with an article to be polished on one chuck while an article carried by the other chuck is being polished, one of the chucks being movable downwardly in one direction in engagement with driving wheels at one side of the frame and the other of the chucks being movable downwardly into engagement with the driving wheels at the opposite side of the frame. Since adjacent chucks engage with driving wheels upon opposite sides of the frame both chucks can be in driving engagement with their supporting and driving wheels at the same time so that a chuck need be in its idle position only for the time required to replace the polished article with another to be polished.

Referring to the modifications shown in Figs. 8, 9 and 10 a suitable supporting frame is provided which has standards 83 at opposite ends thereof which support a tubular pivot shaft 84 which is fixed in bearing members 85 secured to the upper ends of the standards 83. A tubular supporting member 86 is provided with laterally projecting bosses 87 through which the shaft 84 extends and is rotatably mounted upon the shaft. Within the tubular supporting member 86 there is slidably mounted a shaft 88 which has a transverse cylindrical opening adjacent its inner end which receives an eccentric 89 fixed to the shaft 84. A chuck 90 is rotatably mounted upon the outer end of the shaft 88 and this chuck is provided with an article receiving portion 91 which has an outer recessed face of conical form which is preferably provided with a rubber covering 92.

Articles are clamped against the face of the chuck by suitable clamping means carried by a U-shaped bar 93 rigidly secured to the chuck and forming a support for a clamping member 94 which is carried by a rod 95 in threaded engagement with the bar 93 and having a hand wheel 96 by means of which the clamping member may be moved toward and from the face of the chuck.

Rotatably mounted on the shaft 88 between the outer end of the supporting member 86 and the inner end of the chuck 90 there is a bevel gear 97 which is provided on its outer face with clutch teeth 98 which are adapted to be engaged by clutch teeth 99 carried by the chuck 90 on the inner side thereof. The chuck and supporting member are mounted for movement on the shaft 84 from a vertical position to the downwardly inclined position shown in Fig. 9. The eccentric 89 is so disposed on the shaft 84 that the shaft 88 is held in extended position when in vertical position above the shaft 84 so that the clutch teeth 98 and 99 are held out of engagement. When the chuck is moved to a downwardly inclined position the eccentric 89 draws the shaft 88 inwardly and engages the clutch teeth 99 on the chuck with the clutch teeth 98 on the bevel gear 97. The eccentric 89 also limits the downward movement of the chuck, since, when the chuck is drawn inwardly into engagement with the bevel gear, further movement of the shaft 88 with respect to the supporting member 86 is prevented.

The bevel gear 97 is driven by the bevel gear 100 meshing therewith and fixed to a sleeve 101 rotatably mounted on the shaft 84 and having fixed thereto a drive pulley 102.

Attached directly to the chuck 90 upon the rear side thereof there is a ball receptacle 103 which is divided into a series of chambers by means of radial partitions 104. Each of the segmental chambers of the receptacle communicates with the recessed face of the chuck adjacent the axis through an arcuate opening 105.

The shaft 88 is provided with a radial passageway 106 from the outer end thereof to the opening in which the eccentric 89 fits and an opening 107 is provided through the wall of the tubular shaft 84 and through the eccentric 89, the opening 107 being so positioned that the passage 106 in the shaft 88 is brought into registry therewith when the chuck is moved to its downwardly inclined operative position. A cleansing fluid under pressure is delivered into the interior of the tubular shaft 84 and through the opening 107 and passage 106 to the interior of the hollow article, one end of the shaft 84 being attached to a liquid supply conduit and the other end thereof being provided with a plug 108.

When the chuck is in its operative position the balls within the receptacle 103 pass through the openings 105 into the interior of the hollow article held in the chuck, the radial partitions serving upon rotation of the chuck to carry the balls to a position above the axis of the chuck so that the balls will be delivered from the successive chambers of the receptacle during rotation of the chuck. When the chuck is moved to vertical position, the balls pass by gravity into receptacle 103.

In each of the modifications above de-

scribed the chuck is movable from an operative position in which it is continuously driven to an inoperative position in which it is disengaged from its driving means; the balls are automatically fed into the interior of a hollow article on the chuck when it is moved to its operative position and are discharged from the interior of the article when the chuck is moved to its inoperative position; and a cleansing fluid is also delivered to the interior of the hollow article during rotation of the chuck and this fluid is automatically cut off when the chuck is moved to its inoperative position. In the modification shown in Figs. 1, 2 and 3 drain openings are provided for draining excess liquid during operation of the machine. This feature, however, is not essential since the leakage of the cleansing liquid between the rim of the article and the face of the chuck and through the bearings of the chuck may be sufficient to provide the necessary circulation of cleansing liquid.

Having thus described my invention, what I claim is:

1. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to receive polishing material, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, means for rotating said chuck when it is in its operative position, and means for delivering polishing material to said chamber when said chuck is in operative position.

2. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to receive polishing material, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, a drive shaft, means for automatically establishing a driving connection between the drive shaft and chuck when the latter is moved to its operative position, and means for automatically delivering polishing material to said chamber when said chuck is moved to operative position.

3. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to receive polishing material, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, means for rotating said chuck when it is in its operative position, a receptacle for polishing material, and means for automatically delivering polishing material from said receptacle to said chamber when said chuck is moved to operative position and for discharging the polishing material from said chamber when said chuck is moved to inoperative position.

4. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to receive polishing material, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, means for rotating said chuck when it is in its operative position, a receptacle for polishing material, and means for automatically delivering polishing material from said receptacle to said chamber when said chuck is moved to operative position and for returning the polishing material to said receptacle when said chuck is moved to inoperative position.

5. A polishing machine comprising a rotatably mounted chuck having a recessed face and means for clamping an article to be polished against said face to close the recess and form with the chuck a chamber for retaining a mass of polishing material in contact with said article, means for suporting said chuck for movement about a horizontal axis transverse to the axis of rotation of the chuck from a position in which the axis of rotation is inclined downwardly toward the article held in the chuck to a position in which the chuck is above the pivotal axis, a drive shaft, and means for automatically establishing a driving connection between said shaft and chuck when said chuck is moved to its lowermost position.

6. A polishing machine comprising a rotatably mounted chuck having a recessed face and means for clamping an article to be polished against said face to close the recess and form with the chuck a chamber for retaining a mass of polishing material in contact with said article, a supporting member upon the end of which the chuck is mounted, means for supporting said member for pivotal movement about a horizontal axis transverse thereto for movement from a position in which said member is inclined to the horizontal with the chuck at the lowermost end to a position in which the member is vertical with the chuck uppermost, means for driving said chuck, and a receptacle for polishing material carried by said member and in communication with the recessed face of the chuck to deliver said material by gravity to said chuck when said chuck is in its lowermost position.

7. A polishing machine comprising a rotatably mounted chuck having a face adapted to engage with and close the open end of a hollow-ware article and having means for clamping a hollow-ware article against said face whereby a mass of balls may be confined within the hollow article, means for supporting said chuck with its axis of rotation inclined downwardly toward the article supported on the chuck, means for rotating said chuck, and means for delivering a cleansing

fluid into the interior of the article supported on the chuck.

8. A polishing machine comprising a rotatably mounted chuck having a face adapted to engage with and close the open end of a hollow-ware article and having means for clamping a hollow-ware article against said face whereby a mass of balls may be confined within the hollow article, means for supporting said chuck with its axis of rotation inclined downwardly toward the article supported on the chuck, a drive shaft, means for connecting and disconnecting said chuck from said drive shaft, and means controlled by said connecting and disconnecting means for delivering a cleansing fluid into the interior of the article supported on the chuck.

9. A polishing machine comprising a rotatably mounted chuck having a face adapted to engage with and close the open end of a hollow-ware article and having means for clamping a hollow-ware article against said face whereby a mass of balls may be confined within the hollow article, means for supporting said chuck with its axis of rotation inclined downwardly toward the article supported on the chuck, a drive shaft, driving connections including a clutch between said drive shaft and chuck, means for shifting said clutch, and means controlled by said clutch shifting means for delivering a cleansing fluid into the interior of an article supported on the chuck.

10. A polishing machine comprising a supporting member mounted to swing about a horizontal axis, a chuck rotatably mounted upon one end of said member, said chuck having a face adapted to engage and close the open end of a hollow-ware article, and means for clamping an article to the face of the chuck, means connected to said chuck for supporting a mass of balls, means for limiting the movement of said supporting member from an upright position with the chuck uppermost to a downwardly inclined position with the chuck at the lowermost end, means for driving the chuck in its lowermost position, and means permitting said balls to flow into the interior of said hollow article as the chuck is moved downwardly and out of said hollow article as the chuck is moved upwardly.

11. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to confine a mass of balls in contact with the article, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, means for rotating said chuck when it is in operative position, and means for delivering a cleansing liquid into the chamber containing the balls during the rotation thereof.

12. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to confine a mass of balls in contact with the article, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, means for rotating said chuck when it is in operative position, and means for delivering a cleansing liquid under pressure into said chamber containing the balls when the chuck is in operative position and for automatically cutting off the flow of cleansing liquid when said chuck is moved to inoperative position.

13. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to confine a mass of balls in contact with the article, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, means for rotating said chuck when it is in operative position, and means for automatically delivering a mass of balls into said chamber as said chuck is moved to its operative position and for discharging the balls from said chamber as the chuck is moved to inoperative position.

14. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to confine a mass of balls in contact with the article, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, means for rotating said chuck when it is in operative position, means for automatically delivering a mass of balls into said chamber as said chuck is moved to its operative position and for discharging the balls from said chamber as the chuck is moved to inoperative position, and means for delivering a cleansing fluid into said chamber.

15. A polishing machine comprising a rotatably mounted chuck adapted to hold an article to be polished and to form with said article a chamber adapted to confine a mass of balls in contact with the article, a support for said chuck permitting movement thereof bodily from an operative to an inoperative position, means for rotating said chuck when it is in operative position, means for automatically delivering a mass of balls into said chamber as said chuck is moved to its operative position and for discharging the balls from said chamber as the chuck is moved to inoperative position, and means for delivering a cleansing fluid under pressure to said chamber when the chuck is in operative position and for automatically cutting off the flow of cleansing fluid to said chamber when said chuck is moved to inoperative position.

16. A polishing machine comprising a supporting frame, a hollow horizontal shaft fixed

to said frame, a supporting member pivoted to said shaft, and movable from a vertical position past its horizontal position to a downwardly inclined position, a chuck rotatably mounted on the end of said member which is uppermost when said member is in vertical position, said chuck having means for clamping a hollow-ware article to be polished and having a face portion surrounding its axis against which the open end of the article may be clamped, a receptacle carried by said member and adapted to contain a mass of balls, a passageway for balls leading from said receptacle to the face of the chuck adjacent the axis thereof whereby balls are automatically delivered by gravity into the interior of the hollow article when the chuck is moved to its lowermost position, means for driving said chuck, means for admitting a cleansing fluid under pressure to said hollow shaft, and means for establishing communication through the chuck with said hollow shaft to admit the cleansing fluid to the interior of a hollow article on the chuck.

17. A polishing machine comprising a supporting frame, a hollow horizontal shaft fixed to said frame, a supporting member pivoted to said shaft, and movable from a vertical position past its horizontal position to a downwardly inclined position, a chuck rotatably mounted on the end of said member which is uppermost when said member is in vertical position, said chuck having means for clamping a hollow-ware article to be polished and having a face portion surrounding its axis against which the open end of the article may be clamped, a receptacle carried by said member and adapted to contain a mass of balls, a passageway for balls leading from said receptacle to the face of the chuck adjacent the axis thereof whereby balls are automatically delivered by gravity into the interior of the hollow article when the chuck is moved to its lowermost position, means for driving said chuck, means for admitting a cleansing fluid under pressure to said hollow shaft, means for establishing communication through the chuck with said hollow shaft to admit the cleansing fluid to the interior of a hollow article on the chuck, and means controlled by movements of said member for delivering cleansing fluid from said hollow shaft to the interior of a hollow article on the chuck.

18. A polishing machine comprising a supporting member pivoted intermediate its ends for movement in either direction past horizontal position, a chuck rotatably mounted on one end of said member, a receptacle carried by said member at its opposite end and adapted to contain a mass of balls, a passageway from the receptacle to the chuck through which the balls may pass by gravity in either direction depending upon the inclination of said member, means carried by the chuck for clamping a hollow-ware article with its open end against the face of the chuck, with said passageway leading to the interior of the article, and means for driving said chuck when it is in its lowermost position.

19. A polishing machine comprising a supporting member pivoted intermediate its ends for movement in either direction past horizontal position, a chuck rotatably mounted on one end of said member, a receptacle carried by said member at its opposite end and adapted to contain a mass of balls, a passageway from the receptacle to the chuck through which the balls may pass by gravity in either direction depending upon the inclination of said member, means carried by the chuck for clamping a hollow-ware article with its open end against the face of the chuck with said passageway leading to the interior of the article, means for driving said chuck when it is in its lowermost position, and means for admitting a cleansing fluid to said passageway.

20. A polishing machine comprising a supporting member pivoted intermediate its ends for movement in either direction past horizontal position, a chuck rotatably mounted on one end of said member, a receptacle carried by said member at its opposite end and adapted to contain a mass of balls, a passageway from the receptacle to the chuck through which the balls may pass by gravity in either direction depending upon the inclination of said member, means carried by the chuck for clamping a hollow-ware article with its open end against the face of the chuck with said passageway leading to the interior of the article, means for driving said chuck when it is in its lowermost position, and means controlled by the movements of said supporting member for admitting cleansing fluid under pressure to the interior of a hollow article secured to the chuck.

21. A polishing machine comprising a supporting member pivoted intermediate its ends for movement in either direction past horizontal position, a chuck rotatably mounted on one end of said member, a receptacle carried by said member at its opposite end and adapted to contain a mass of balls, a passageway from the receptacle to the chuck through which the balls may pass by gravity in either direction depending upon the inclination of said member, means carried by the chuck for clamping a hollow-ware article with its open end against the face of the chuck with said passageway leading to the interior of the article, a drive shaft, and means for automatically establishing a driving connection between said drive shaft and chuck when said chuck is moved to its lowermost position.

22. A polishing machine comprising a rotatable chuck having a face against which the open end of a hollow-ware article is adapted to fit and having means for clamping the article against said face, a support for said

chuck permitting movement thereof bodily from an operative to an inoperative position, a drive shaft, means controlled by movements of the chuck to and from operative position for connecting and disconnecting said drive shaft and chuck, means controlled by movements of the chuck to and from operative position for delivering balls into and discharging the same from the interior of a hollow article on the chuck, and means controlled by movements of the chuck to and from operative position for delivering a cleansing fluid to the interior of said hollow article.

23. A polishing machine comprising a supporting member pivoted intermediate its ends for movement in either direction past horizontal position, a chuck rotatably mounted on one end of said member, a perforated receptacle carried by said member at its opposite end and adapted to contain a mass of balls, a passageway extending axially through said member from the receptacle to the chuck, means carried by the chuck for clamping a hollow-ware article with its open end against the face of the chuck around said passageway, means for driving said chuck when it is in its lowermost position, and means for admitting a cleansing fluid under pressure to said passageway.

In testimony whereof, I hereunto affix my signature.

ARNOLD L. BROWN.