Sept. 8, 1953 H. V. SCHWEITZER 2,651,282

EDGE-LINING MACHINE

Filed Aug. 21, 1947 4 Sheets-Sheet 1

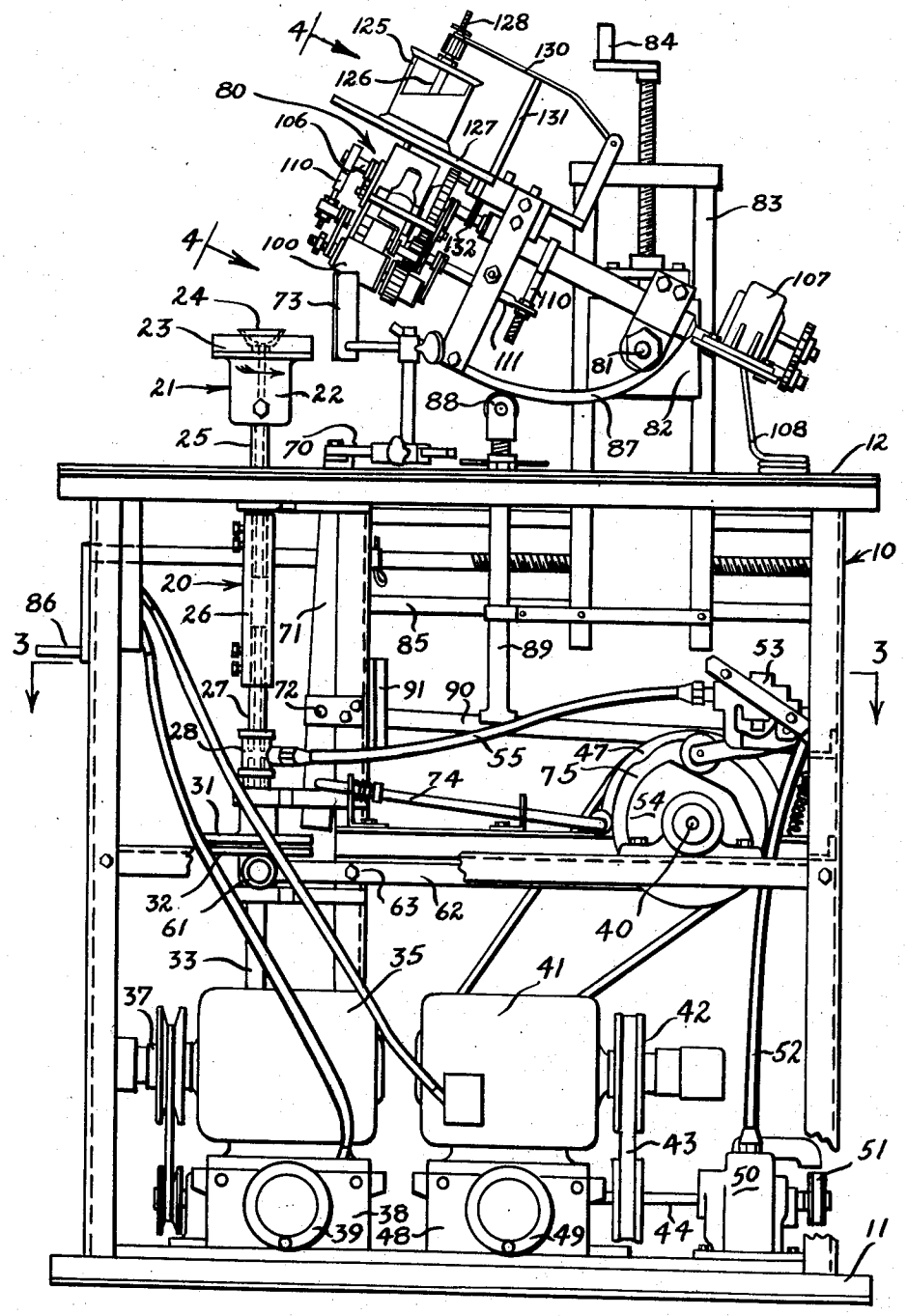


Fig. 1.

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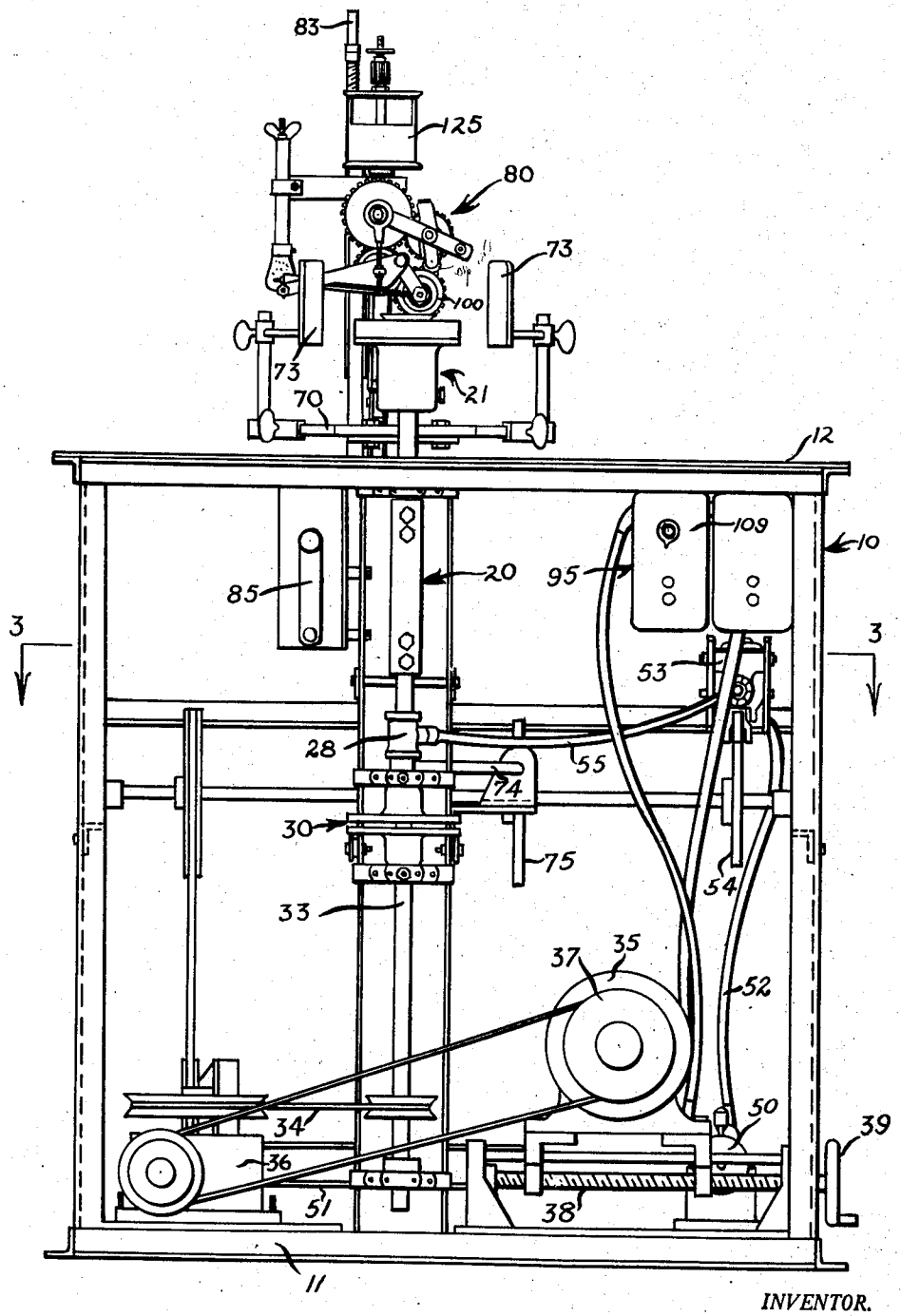


Fig. 2.

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EDGE-LINING MACHINE

Filed Aug. 21, 1947 4 Sheets-Sheet 3

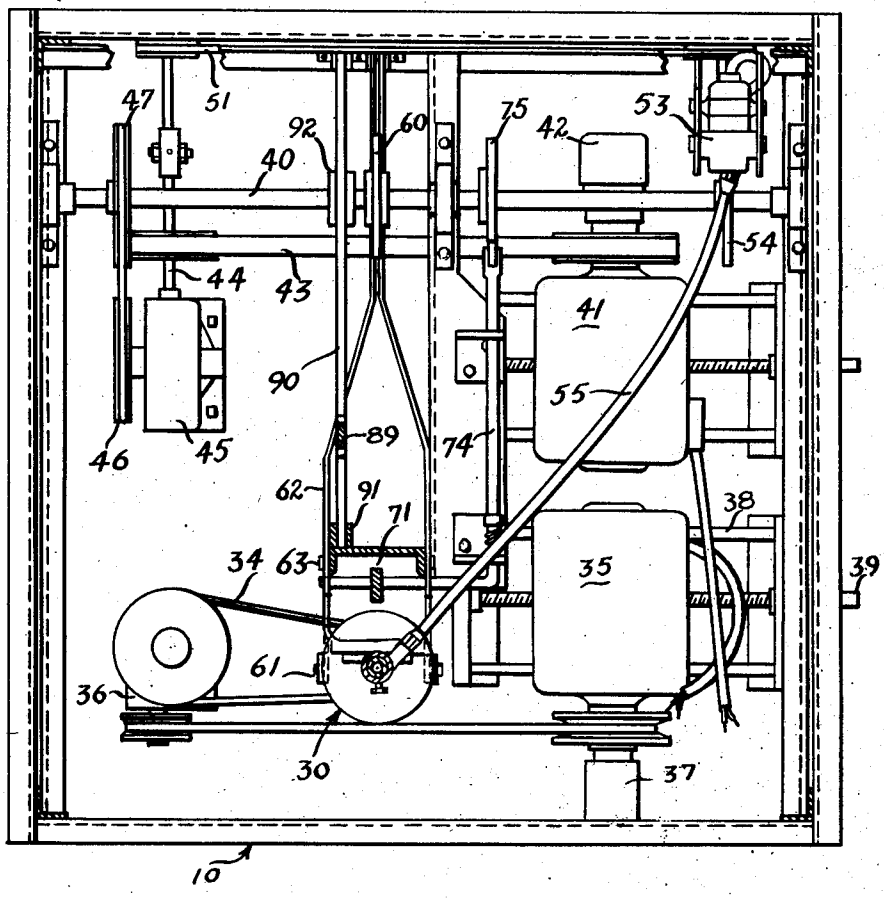


Fig. 3.

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EDGE-LINING MACHINE

Filed Aug. 21, 1947 4 Sheets-Sheet 4

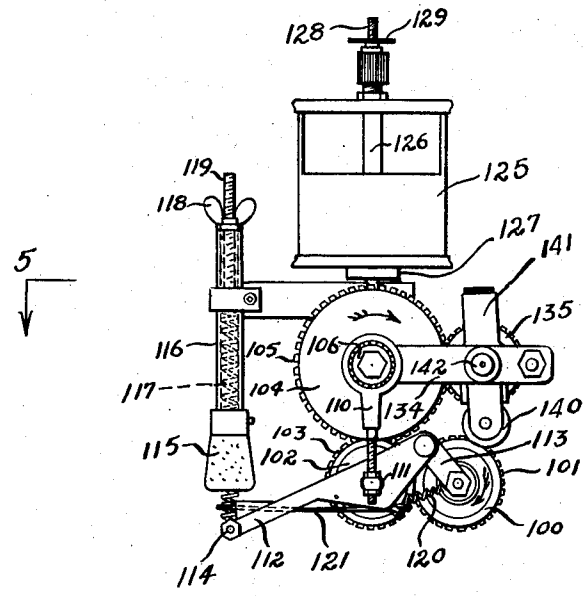


Fig. 4.

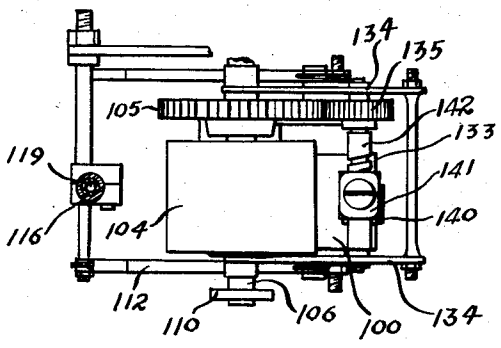


Fig. 5.

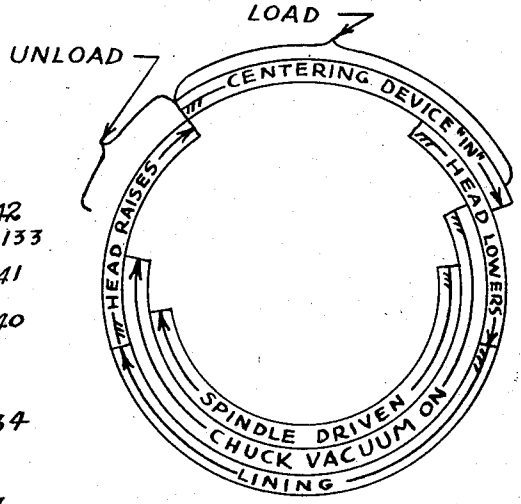


Fig. 6.

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Patented Sept. 8, 1953

2,651,282

UNITED STATES PATENT OFFICE

2,651,282

EDGE-LINING MACHINE

Howard V. Schweitzer, Shaker Heights, Ohio

Application August 21, 1947, Serial No. 769,940

7 Claims. (Cl. 118—1)

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This invention relates to a machine for applying lines or bands of color, usually gold, to the edges of dishes or similar flatware of china, pottery, or the like.

Heretofore, the well-known bands or lines applied to the edge or rim of dishware were usually applied by brush. Such hand decoration was time-consuming and wasteful of the color, since it was impossible for even the most skillful decorator to obtain an even thickness of coating. In the case of gold bands, this was expensive, not only because of the cost of gold but also because the possible heavy coatings of gold made the ware subject to luxury taxes.

Several efforts have been made to devise means for applying such edge lines mechanically, but heretofore no fully satisfactory mechanism has been obtained which met the numerous requirements involved, of which the following are several of the principal ones:

The color is very slippery and, furthermore, is generally applied over the glaze, with the result that the color, especially gold, is likely to be smeared or wiped during application due to the tendency of the application means to skid on the glaze. Such wiping or skidding must be avoided.

It was difficult to control either the thickness of the applied color, especially gold, or the width of the edge line. This must be done if satisfactory lining is to be obtained and if luxury taxes are to be avoided or minimized.

The ware comes in numerous shapes and sizes, frequently with fluted or scalloped edges. Even ware which has a circular edge varies from piece to piece for ware of a given size. This is due to the fact that the rim of a dish, for example, may shrink or warp during firing, such shrinkage and warping not only varying from piece to piece but also around the rim of a given piece. A satisfactory edge lining machine must be able to handle different kinds and sizes of ware as well as variations between different pieces of a given size and kind.

In addition to the variations between ware, the desired style of decoration will vary both as to the location of the line with respect to the edge of the ware and the width of the line. That is, the location of the line may have to vary from a position on top of the edge (so that the entire width of the edge line may be seen on the top of the plate) to a position on the vertical side of the edge (in which even the line can hardly be seen from the face of the plate but is seen from the side view, as when the plates are stacked). A satisfactory edge lining machine

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must be able to apply lines of the desired width to the desired location on the edge of the ware.

Few of the prior efforts to provide a ware edge-lining machine ever endeavored to solve all of the above-outlined problems. It is an object of this invention to provide a relatively simple mechanism which satisfies and meets all of the several requirements.

In general, a machine made according to this invention employs a chuck upon which an unskilled operator simply places the unlined ware and removes it after it has been lined. This is the only manual operation involved and, of course, may be conducted by wholely unskilled labor, rather than by the relatively highly skilled labor required heretofore. When the ware is placed on the chuck, guides are in position so that the ware is well centered, though it is not necessary that the ware be precisely centered. Thereafter, the centering guides are withdrawn and the ware is rotated on the chuck. A lining head, described in greater detail below, is then lowered onto the rim of the dish. The dish is then lined by means of a lining roller which is carried by the head. The lining roller is positively and evenly coated at all times as well as being positively driven at a speed synchronized to the speed of the rim of the dish. In addition to being so positively driven and coated, the lining roller is also floated in such a manner that scallops and flutes as well as warping and eccentricity of the dish may be accommodated. The lining head is so mounted that the position and width of the line may be controlled.

The edge lines on ware decorated by this machine are precisely controlled as to thickness and are uniform in width, not only as to the line around a single dish but from dish to dish. Only the most skilled hand decorators can produce a line of uniform width around a dish and even such lines will vary in width from dish to dish. Furthermore, one of my machines will have a much greater production rate than a hand decorator, in addition to producing better lines. For example, on a size of dish which a very fast decorator can edge line at the rate of fifteen to seventeen dozens an hour (seventeen to twenty seconds per dish), my machine can decorate more uniformly at the rate of 120 dozens per hour (two and a half seconds per dish).

Other objects and advantages of my machine will be apparent from the following specification, claims, and drawings in which:

Fig. 1 is a side elevation, partly broken away,

of a preferred embodiment of a machine made according to this invention.

Fig. 2 is a front elevation of the machine shown in Fig. 1, but showing the lining head lowered to a lining position.

Fig. 3 is a cross-section of the machine taken along the lines 3—3 of Figs. 1 and 2.

Fig. 4 is a detailed front elevation of the lining head taken along the line 4—4 of Fig. 1.

Fig. 5 is a detailed section taken along the line 5—5 of Fig. 4.

Fig. 6 is a circular graph showing the cycle of operation of the machine and the relative timing of the operation of several elements during such a cycle.

The machine shown in the drawings is comprised of a frame 10 having a base 11 and table top 12, the frame 10 having suitable structural elements to support various elements and subassemblies of the machine, as will be described in detail below. The casing which normally encloses the frame is omitted in the drawings for purposes of illustration.

Spindle and spindle drive

A spindle drive shaft assembly 20, located forwardly in the frame 10 and mounted in suitable bearings, extends vertically from near the base 11 through the top 12, where it supports a chuck 21. The chuck 21 is comprised of chuck hub 22, a chuck ring plate 23 and a rubber suction cup 24 having a hollow stem connected to the hollow interior of the chuck hub. The spindle drive shaft assembly 20 is comprised of a tube 25 supporting the chuck hub 22 and a sleeve 26 adjustably connecting the tube 25 to a tube 27 so that the height of the chuck 21 above the table top 12 may be adjusted as desired. The tube 27 passes through a hollow vacuum collar 28 (where the tube 27 is suitably ported) and is connected to the driven plate 31 of the clutch 30.

The driving plate 32 of the clutch 30 is slidably mounted on the solid clutch shaft 33 for movement in and out of engagement with the driven plate 31. The clutch shaft 33 is driven by the fixed-speed spindle driving motor 35 through the geared speed-reducer 36, the speed-reducer 36 and clutch shaft 33 being connected by suitable drive such as the V-belt and pulley drive 34. The motor 35 is likewise connected to the speed-reducer 36 by means of a V-belt drive, the motor 35 carrying the expansible V-belt pulley 37. The motor is slidably and adjustably mounted on the base 10 by means of the screw shaft motor support 38 so that the hand wheel 39 will permit the distance between the motor 35 and the speed-reducer 36 to be varied, whereby the V-belt connecting the motor and speed-reducer will cause the effective diameter of the pulley 37 to expand or contract and, thus, permit the rotational speed of the clutch shaft 33 to be infinitely varied within the limits permitted by the screw shaft motor support 38 and the expansible pulley 37.

Other means may be employed to regulate the speed of the chuck 21, the disclosed means being preferred since, by selection of the fixed reduction ratio of the geared speed-reducer 36 and the fixed speed of the motor 35, it is possible to vary the speed of the chuck simply and to hold the adjusted speed constant, in order that the peripheral speed of the ware carried by the chuck 21 may be controlled within the limits of accurate speed variations of the lining roll 100, as explained below. It should be apparent that, for ware of small diameter, the speed of the spindle shaft 20 should be increased and, for ware of large diameter, the speed of the shaft 20 should be decreased so that the peripheral speed of the ware will remain within the operative limits of the lining roll 100.

Cam shaft drive

Except for the adjustment of the rotational speed of the lining roll 100 of the lining head 80, all operations of the machine are controlled in timed relationship with each other by means of the cam shaft 40. The cam shaft 40 carries the various cams which operate the several subassemblies and is driven by means of a cam shaft motor 41 through an expansible pulley 42, V-belt 43, speed-reducer input shaft 44, geared speed-reducer 45, speed-reducer output pulley 46, and cam shaft pulley 47. The cam shaft motor 41 is likewise mounted on a screw shaft base 48 so that, by turning the hand wheel 49, the speed of the speed-reducer input shaft 44 may be varied by operation of the expansible pulley 42.

Because all operations affecting the cycle of operation of the machine are controlled by the cam shaft 40, the length of each cycle is controlled by adjusting the rotational speed of the input shaft 44 by means of the hand wheel 49. Within the cycle of operation, the duration of each operation is controlled by the respective cam controlling such an operation. For simplicity of illustration, each cam is shown as a fixed cam, and such fixed cams are used in many production machines where the desired relative duration of each operation is established. It is to be understood, however, that for maximum flexibility of operation, each or any one of the cams on the shaft 40 may be a so-called split cam comprised of segments adjustable with respect to each other in order that the effective length of the cam face may be adjusted and, thus, that the duration of any operation in the cycle and the timing of such operations with respect to each other may be adjusted.

Chuck vacuum line and operation

In order to provide vacuum for operation of the ware chuck 21, the speed-reducer input shaft 44 is extended through a suitable flexible coupling to a V-belt drive 51 which drives the vacuum pump 50. The pump 50 is connected by a line 52 to a vacuum valve 53 opened and closed by a suitable cam follower operated by the vacuum cam 54. The vacuum valve 53 is connected by the line 55 to the hollow collar 28 in which the tube 27 is journaled. The journaled portion of the tube 27 is provided with suitable drilled ports opening to the interior of the spindle shaft 20.

The lip of the vacuum cap 24 normally extends above the chuck ring plate 23 a sufficient distance to engage the bottom of ware placed on the chuck so that the foot of the ware rests in the plate 23. Thus, when ware is placed on the chuck plate 23 and the vacuum valve 53 is opened by the cam 54, ware is held on the chuck 21 until the vacuum is released by the cam 54, the vacuum line running from the interior of the cup 24 through the spindle shaft 20, collar 28, line 55, vacuum valve 53, line 52 to the constantly operating pump 50.

Spindle clutch operation

The clutch shaft 33 is constantly driven by the motor 35 through the above-described drive, but the spindle 20 and chuck 21 rotate only when the

plates 31 and 32 of the clutch 30 are engaged. To engage the clutch 30 and rotate the chuck 21, the clutch plate 32 is raised into engagement with the plate 31 by the rollers 61 raised by the clutch cam 60 (see Fig. 3) by means of the yoke 62 mounted on the pivot pins 63. As indicated diagramatically in Fig. 6, the operating face of the clutch cam 60 is slightly shorter than the operating face of the vacuum valve 54, the cams being indexed with respect to each other on the cam shaft 40 so that the vacuum will hold ware on the chuck 21 before the chuck 21 rotates and continues to hold the ware until shortly after the clutch 30 is disengaged and the chuck is no longer driven. Thus, the ware will firmly hold on the chuck during its rotation so that any dynamic imbalance of the ware will not displace the ware from its geometrically centered position on the chuck.

Centering device and operation

Most edge-lined flat ware, cups, bowls, saucers, and the like, are designed to have an edge which, except as modified by flutes or scallops, is as nearly circular as possible and the illustrated embodiment is designed to edge-line such ware. Even the present embodiment, however, can accommodate ware having a polygonal edge provided that the difference between the maximum and minimum radii from the geometric center of the ware does not exceed the length of the lining roll 100, and the difference betwen the maximum and minimum instant peripheral speeds does not exceed capacity of the lining roll mounting and length of the lining roll drive gear teeth to accommodate such differences, as will be explained below.

To quickly and accurately center the ware on the chuck 21, the machine is provided with a centering yoke 70 located above the table surface 12 and carried by the vertical staff 71 which extends below the table surface, the staff 71 being mounted on the horizontal pivot 72. Each of the angularly disposed arms of yoke 70 carries an adjustably mounted centering plate 73. With the staff 70 pivoted to its most forward or inward position, the plates 73, in order to center circular ware, are mounted so that perpendiculars to the vertical center line of each plate will intersect at the center line of the spindle 20. Thus, with the centering plates 73 adjusted along the yoke arms for a given size of circular ware, say a dinner plate, and with the staff 71 pivoted to its "in" position, one need only to place the ware on the chuck 21 and press it against the centering plate 73 to center the ware on the chuck wtihin the limits of accuracy permitted by the variations in each dinner plate. If the ware is polygonal, the plates 73 should be adjusted so that, when the plates 73 are engaged by a straight side of such ware, the ware will be similarly centered. If the edge of the ware is provided with such large flutes or scallops or is otherwise provided with such an irregular edge that the plate may fall into the irregularities and fail to center the ware, then the plates 73 may be configured to key into such irregularities and, thereby, insure accurate centering.

To pivot the staff from its "in" position to the normal "out" position, which permits the ware to rotate on the chuck, the lower end of the staff 71 is connected to the spring-pressed cam follower 74 adjacent the staff pivot 72. The guided follower 74 rides against the face of the centering cam 75, moving the yoke and centering plates "in" and "out" in timed relationship to the other operations of the machine. As indicated in Fig. 6, the centering device moves "in" for a sufficient period of time to allow ware to be centered, the "in" period terminating after the chuck vacuum is on but before the spindle is driven. Thus, the ware is held on the chuck in its centered position but the yoke 70 moves "out" before the ware commences to rotate; consequently, the edge of the ware does not strike the centering plates as it rotates.

Lining head mounting and operation

The lining head 80 is mounted on the pivot 81 carried by the cross-head 82 which is vertically adjustable in its vertical ways 83 by means of the crank-handled jack screw 84. The vertical ways 83 extend through a slot in the table top 12 and, themselves, are adjustably mounted in the horizontal ways 85 by means of the crank-handled jack screw 86.

As explained at the outset, different designs of decoration for ware require a different location of the line over the edge of the ware, that is, the location of the line may vary from a position on substantially the vertical portion of the ware's edge to a more common position on the horizontal portion of the ware's edge, though most lines are placed in an intermediate position (more nearly horizontal than vertical) in order that the line will be seen in plan and edge views of the plate (though seen more predominantly in a plan view). The position of line about the edge of ware is determined by its width and the angle of the face of the lining roll to the edge of the plate.

In order to provide for an adjustment of the angle of the lining roll to the edge of the ware, the lining head 80 carries the curved lifting cam track 87, the cam track 87 curving downwardly and forwardly from a position adjacent the pivot 81 in a more or less parabolic or logarithmic curve. The cam track 87 rests upon the follower 88 adjustably mounted in the vertically slidable rod 89, which, in turn, is carried by the vertical ways 83. Thus, the angle at which the lining roll 100 contacts the edge of ware is determined by the vertical distance between the pivot 81 and the follower 88 when the head is in its lining position.

The lifting rod 89 rides on the head-lifting lever 90 which is pivoted at the rear of the machine and guided at its forward end by the guides 91. The lever 90, in turn, rides on the head lifting cam 92 so that, during the dwell of the cam 92, the head is lowered to its lining position but, during a portion of each cycle, the rise in the cam 92, by means of the lever arm 90, lifting rod 89, follower 88, and track 87, raises and lowers the head 80.

The lifting face of the cam 92 is of such length and so indexed with respect to the other cams on the shaft 40 that the head is not fully lowered to lining position until after the chuck vacuum is on and the spindle is driven. This insures that ware is rotating at speed before actual lining commences. Since actual lining is the key operation of the machine, the spindle drive and chuck vacuum are timed to cease shortly after the end of the lining period, as indicated in Fig. 6 of the drawings. The ware must obviously be unloaded, loaded and centered during a period of the cycle opposite the lining period and, accordingly, the operation of the centering device is so timed, though, as shown in Fig. 6, the cycle

time may be shortened by overlapping the time the centering device is "in" and the time the head is lowered and by employing at least a part of the time required to raise the head as all or part of the time for unloading ware from the chuck 21.

Lining roll drive, mounting, and operation

In order to avoid appreciable skidding of the lining roll 100 with the edge of the ware and consequent smearing and wiping of the line, the lining roll is driven at a speed so that the lining surface of the roll 100 has a peripheral speed equal to the means peripheral speed of the edge of the ware. The lining roll 100 is accordingly driven, as best shown in Fig. 5, by a lining roll gear 101 meshing with the gear 103 of the transfer roll 102 which, in turn, is driven by the gear 105 of the feed roll or drive roll 104. The pitch diameters of each of the gears is equal to the diameter of each of the rolls in order that the surface of the rolls will run in contact with each other while being driven by the gears. The feed roll 104 is mounted on the shaft 106 which, in turn, is driven by the geared variable-speed small motor 107 carried at the rear of the lining head 80. The current for the motor is supplied by the line 108 through the speed control 109, most conveniently located at the front of the machine on the control panel 95 on which the starter buttons for the motor 35 and 41 are located. Different makes of such variable-speed small motors will have different speed ranges in which the speed control is accurate. Accordingly, the rotational speed on the chuck 21 should be adjusted by operation of the hand wheel 39 to bring the peripheral speed of the ware on the chuck into the range in which the peripheral speed of the lining roll 100 may be accurately controlled by the motor 107. It is to be understood, however, that the motor 107 may be a fixed speed motor, synchronization of the peripheral speeds of the ware and lining roll 100 being obtained entirely by operation of the hand wheel 39, or, particularly if the machine is to be used for a relatively small range of ware sizes, the base 38 and pulley 37 may be eliminated to operate the spindle 21 at a constant speed, synchronization of peripheral speeds thus being obtained by control of the motor 107 above.

As best shown in Figs. 2 and 4, the lining roll 100 is suspended by a linkage capable of allowing the roll to float on the edge of the ware while the roll is positively driven. Such linkage comprises the hangers 110 rotatably mounted about the shaft 106 to support the shaft 111 of the transfer roll 102. Pivoted on the shaft 111 are the toggle arms 112 which carry the pivoted links 113, the links 113 carrying the shaft for the lining roll 100. The ends of the toggle arms opposite the links 113 are joined by a bolt 114 normally held against the soft tubular sponge rubber bumper 115 of the tube 116 by the spring 117 which is normally contracted within the tube 116. The tension on the spring 117 is adjustable by means of the wing nut 118 which bears against the upper end of the tube 117 and is threaded on the spring bolt 119. The lining roll 100 and its gear 101 are held in engagement with the transfer roll 102 and its gear 103, respectively, by lining roll tension springs 120 connected to the free ends of the links 113 and to the threaded tension rods 121 carried by the toggle arms 112. A nut on each threaded tension rod allows the tension of the springs 120 to be suitably adjusted. In Fig. 2 the rolls are shown in their normal position and in Fig. 4 the rolls are shown in their position when the toggle arms 112 are in their maximum toggled positions. The position of the lining roll 100 and tube 117 with respect to the driving roll are shown for counter-clockwise rotation of the chuck 21 and clockwise rotation of the lining roll 100.

The face of the lining roll 100 is rubber, preferably rather soft, since the width of the applied line is controlled by the indentation which the edge of the ware makes in contacting the lining roll surface. To set the machine up for applying a desired line, the tensions on the springs are set to apply a line of the desired width, a sample piece of the ware to be lined is centered on the chuck 21, and then the head 80 is lowered until the pressure of the roll 100 on the ware opens the toggles 112 to about half the full open position shown in Fig. 4 and also slightly opens the angle between the toggle arms 112 and links 113 against the tension of the spring 120. The lining roll 100 is then floating on the edge of the ware under the tension of the springs 117 and 120. In this connection, it should be pointed out that, while the teeth of the gears 101, 103, and 105 are indicated diagrammatically in the drawings for simplicity of the illustration, they are, in practice, involute teeth which permit a variation of the distance between the centers of the gears 101 and 103.

With roll 100 floatingly mounted in the manner described above, the machine can accommodate any warping or variation in wall diameter in ware of a given size, as will occur in any ware which would pass any acceptable production standards as well as any eccentricity which may occur in centering the ware on the chuck 21. The principal variation which must be accommodated is warping of the rim, which variation will be accommodated by the rocking of the roll 100 on the toggle arms 112. The accommodation of the slight differences in instant peripheral speed of the edge of the ware due to eccentricity of the ware, or warping, scallops or flutes in the edge of the ware is also provided by the floating mounting of the lining roll 100. If the instant peripheral speed of the ware is slightly greater than the instant peripheral speed of the roll 100, the roll 100 will tend to be dragged along with the edge of the ware, closing up the toggle arm angle and closing up the angle of the link 113 with respect to the arms 112. If the instant peripheral speed of the ware is slightly less than that of the roll 100, the roll 100 will tend to creep ahead along the advancing edge of the ware, closing the angle of the toggle arms 112 and opening the angle of the links 113. It is because of the capability of the floating support of the lining roll 100 to accommodate variations in the instant peripheral speed of edges of the ware as well as to accommodate variations in the height of the edge with respect to the plane of the chuck plate 23 that my machine is able to line ware having a fluted or scalloped edge as well as ware having a perfectly circular edge. The minimum radius of a flute or scallop which my machine may line is, of course, determined by the radius of the roll 100, and the diameter of the roll 100 is selected accordingly. If there is a substantial variation in the instant peripheral speeds of the ware, as in the case of very deep scallops or when the ware is substantially square or has a similar polygonal shape of a relatively few number of sides, the length of the roll must be increased

and, preferably, the rolls are tapered to aid in accommodating such wide variations in peripheral speed.

Color supply and control

The color for application by the roll 100 is supplied from the reservoir, which comprises a cup 125 having a central tube 126, ported at its bottom to allow color, such as gold, to run into the tube, which extends through the reservoir supporting plate 127 and from which the color is fed in drops onto the feed roll 104.

The amount of color which is supplied from the cup 125 or, rather, the rate at which drops of color fall on the feed roll 104 is controlled by the length of the stroke of the plunger rod 128 which moves in the tube 126. If the stroke of the rod 128 is short, several strokes may be required to pass one drop of color; if the stroke is long, several drops may pass at one stroke. The rod 128 is actuated by an arm 130 which is engaged between a shoulder on the rod 128 and a nut 129 on the threaded end of the rod. The arm 130 is lifted by a cam pin 131 which rides on a single lift cam 132 on the feed roll shaft 106. Thus the arm 130 is lifted once for each revolution of the shaft 106 but the length of the stroke of the rod 128 is regulated by the amount of lost motion adjustably permitted by the turning of the nut 129 on the threaded end of the rod 128. The rate of flow of color to the lining roll 100 is, therefore, simply and easily controlled by the adjustment of the nut 129 on the rod 128.

As drops of color fall on the feed roll 104, they are carried on its surface to transfer roll 102. There the drops of color spread out into substantially uniform films, one being carried by the feed roll 104 and the other by the transfer roll 102. The film on the transfer roll 102 is then transferred to the lining roll 100, from which, of course, the color is transferred to the edge of the ware at the areas at which the edge of the ware contacts the surface of the lining roll 100. The thickness of the film transferred from the roll 100 to the ware is controlled by the viscosity of the color vehicle and the pressure between the feed roll 104 and the transfer roll 102. The viscosity of the color vehicle is, of course, controlled by the addition of suitable thinner to the color and the pressure between the rolls is adjusted by means of the nuts which support the transfer roll shaft 111 on the hangers 110.

While the lining roll 100 is in contact with the edge of the ware, the roll 100 will, of course, make several revolutions for each revolution of the ware. When ware with a true circular edge is being lined, and thus most commonly, the only portion of the surface of the lining roll 100 transferring color to the ware will be a narrow band about the surface of the roll 100. While an integer of the band of the roll 100 which contacts the ware will usually contact the transfer roll 102 before the integer again contacts the edge of the ware, and thus would pick up color from the transfer roll 102, the line on the ware would not be uniform as to thickness or width, for two principal reasons. First, due to the "knee action" of lining roll supporting link 113 with respect to the toggle arms 112, the lining roll 100 may not always be in contact with the transfer roll 102 during actual lining. Second, even assuming that there was no "knee action" of the link 113, during the time that the lining roll 100 was out of contact with the ware, the color would build up the lining roll to a thickness greater than that which could be instantaneously supplied by the transfer roll while the lining roll was in contact with the edge of the ware. Consequently, even without the effect of the "knee action" of the link 113, the line applied to the ware would be thick and wide at the point at which the ware first engaged the roll 100 and, by the time the lining roll had made several revolutions, the line would be light and thin. With the "knee action," the line would not only tend to "run out" but might well be interrupted and blotchy. In addition to these difficulties, during the lining of ware of a given size and kind, most pieces will be quite uniform and, consequently, the area of contact of the lining roll 100 will be a relatively narrow band. While color is being transferred from a relatively narrow band, the color on the remaining area of the lining roll 100 will tend to skin and build up to thickness which would render the color transfer mechanism inoperative.

To obviate the above difficulties, I employ a spreaker roll 140 of a substantially shorter length than the lining roll 100. The spreader roll 140 is carried by the split-nut housing 141 which is traversed on the shaft 142 by means of a split nut (not shown), which travels in the endless reverse pitched thread 133 in the shaft 142. The shaft 142 is carried by arms 134 pivotally mounted on the feed roll shaft 106 so that the spreader roll 140 will always ride on the lining roll 100, regardless of the knee action of the link 113 or the toggling of the arms 112. The shaft 132 is continuously driven by the pinion 135 which meshes with the gear 105 of the feed roll 104. Thus, the spreader roll, rotated by frictional contact with the roll 100, is continually traversing the lining roll 100 and maintains a uniform film of color on the surface of the lining roll regardless of whether the roll 100 is in actual lining contact with the ware or not. Even though, due to the knee action of the link 113, the lining roll 100 should be out of contact with the transfer roll 102 during a substantial portion of the actual lining period, the color on the whole face of the roll 100 constitutes a sufficient reservoir to maintain a uniform film of color on the relatively narrow band from which color is transferred to the edge of the ware.

Summary of operations

In view of the foregoing, the operation of my lining machine may be summarized briefly as follows:

With speed of the spindle 20 and the lining roll 100 adjusted so that the peripheral speed of the ware to be lined will be equal to that of the roll 100, and with the height and angle of the lining head adjusted so that a line of the desired width will be placed at the desired position on the edge of the ware, the speed of the cam shaft 40 is set for the desired time of a lining cycle. There are two principal factors which determine this time. First, there must be sufficient time until the lining head 60 is raised (which time may include that for raising and lowering the head) for the operation to unload and load the ware. Second, the lining roll 100 must be in contact with the edge of the ware a sufficient length of time so that one revolution of the ware will be made during such contact. As indicated in Fig. 6, these two times are about equal, so that, in a two and one half second cycle, about a second is required to unload and load and another second to line. A cycle of this duration will be adequate for most ware and, accordingly, will provide a production

rate of about 120 dozen pieces of ware an hour for most ware.

In a given cycle, and with the machine adjusted for placing the desired line upon ware of a given size and shape, the cycle commences when the operator places the ware on the chuck 21 and against the centering plate 73 to effect a substantially geometric centering of the ware on the chuck, the plates 73 being "in" at this period of the cycle. The cam 54 thus opens the vacuum valve 53, so that the vacuum cup 24 will hold the ware on the ring plate 23 and shortly thereafter the spindle 20 commences to rotate, the clutch 30 having been engaged by operation of the clutch cam 60. By the time the vacuum has turned on and the spindle commenced to rotate, the centering yoke 70 has been withdrawn, by operation of the cam 75, to clear the ware, and the lining head 80 has commenced to lower, by operation of the cam 92. Thus, by the time the centered ware held on the spindle has reached its speed of rotation, the lining roll 100 will contact the edge of the ware. On so much of the edge of the ware as contacts the color on the lining roll 100, a line will be drawn by the color transferred from the roll 100. The thickness and width of the line will be uniform, as explained above. The linkage by which the roll 100 is mounted will allow for warping and instant eccentricities of the edge of the ware contacted by the roll 100, as also explained above.

After the edge of the ware is lined, in rapid sequence the head 80 commences to raise, the spindle clutch 30 disengages, and as the chuck 21 stops rotation, the vacuum line is closed and the vacuum cup 24 releases the ware so that it may be removed from the chuck. By the time the lined ware is removed, the centering device is "in" again and the machine is ready to commence a new cycle.

From the foregoing it should be apparent that my machine accomplishes the various objects of the invention and also that it may be modified by those skilled in the art to accomplish the same ends or to meet special conditions of ware to be lined without departing from the spirit or scope of this invention. This invention, therefore, is not limited to the preferred embodiment disclosed but by the appended claims.

What is claimed is:

1. In a machine for lining the edge of ceramic dishware and the like, a vacuum chuck comprising a ware support and a vacuum cup adapted to engage ware placed on said support, a hollow spindle carrying said chuck, the interior of said spindle communicating with the interior of said vacuum cup, a source of vacuum, a line connecting said source to the interior of said spindle, and a valve interposed between said source and said cup to control the operation of said cup in holding and releasing ware placed on said ware support; a clutch, a variable speed first drive means connected to said spindle through said clutch; a centering device adjacent said chuck and comprising adjustably spaced members and means to move said adjustable spaced members toward and away from a position where said members are adjusted to center, on said chuck, ware placed in contact with said members; a lining head mounted adjacent said chuck and comprising a color-carrying, resiliently-surfaced lining roll having an axial length greater than the width of the line to be inscribed, a driving feed roll, and an intermediate transfer roll in rolling contact with said drive roll, second positive drive means for said driving feed roll to drive said lining roll through said transfer roll, means for resiliently supporting said lining roll to permit angular and radial movement of said lining roll with respect to said transfer roll and urging said lining roll toward rolling contact with said transfer roll, means to supply color to said driving feed roll at a substantially continuous rate, whereby said color is supplied to said lining roll when said transfer roll is in contact therewith, means to regulate the rate at which color is supplied to said driving feed roll, adjustable means to support said lining head so that said lining roll will engage the edge of ware carried by and centered on said chuck; means to drive said driving feed roll so that the peripheral speed of said lining roll is substantially equal to the peripheral speed of the ware, and means continuously distributing the color on said lining roll; and means to move said lining head in and out of engagement with ware on said chuck, engage and disengage said chuck, operate said vacuum valve, and operate said centering device in timed relationship with respect to each other during a cycle of operation.

2. In a ware decorating machine, a lining head for applying a line of color to the edge of rotated ware comprising a drive roll, means to drive said drive roll, a transfer roll in rolling contact with said drive roll and continuously driven thereby, a lining roll having an axial length greater than the width of the line to be inscribed and having a resilient surface and continuously driven by said transfer roll, means for mounting said lining roll to permit limited angular and radial movement of said lining roll with respect to said transfer roll and resiliently urging said lining roll into rolling contact with said transfer roll, whereby color supplied to said driving roll will be transferred and supplied in a film to said lining roll when said drive, transfer, and lining rolls are, seriatim, in rolling contact, means to supply color to said driving roll, means to regulate the rate at which color is supplied to said driving roll, means to distribute the color on said lining roll, said lining roll mounting means comprising a pivotally mounted toggle arm and a link pivoted to said toggle arm, said link carrying said lining roll, springs acting upon said arm and link to urge said lining roll in contact with said transfer roll, said means to supply color to said roll comprising a reservoir and conduit therefrom to said driving roll, and said means to regulate the rate at which the color is supplied to said driving roll comprising a variable stroke piston interposed in the conduit from said reservoir to said driving roll, a member reciprocated by said means for driving said driving roll, a lost motion linkage connecting said member to said piston, and means to vary the lost motion in said linkage to vary the stroke of said piston.

3. In a ware decorating machine of the class described, a ware-holding chuck, a lining head comprising a roll to scribe a line on the edge of ware carried by said chuck, said roll having an axial length greater than the width of the line to be inscribed, means controlling the operation of said chuck to enable ware to be held on said chuck and to be released therefrom, means to move said lining head from an operative ware edge-lining position to an inoperative position, and means controlling the operation of said chuck operating means and said lining head

moving means to effect operation of said chuck at all times while said lining head is in its operative edge-lining position, said control means comprising a lining head movement cam, a chuck operating cam, and a common cam shaft therefor, the chuck operating cam having a longer operative cam face than said lining head movement cam, the lining head movement cam being indexed on said cam shaft so that it will be in an operative position only while said chuck operating cam is in an operative position.

4. In a ware decorating machine of the class described, a ware-holding chuck, a lining head comprising a roll to scribe a line on the edge of ware carried by said chuck, said roll having an axial length greater than the width of the line to be inscribed, means controlling the operation of said chuck to enable ware to be held on said chuck and to be released therefrom, means to move said lining head from an operative ware edge-lining position to an inoperative position, and means controlling the operation of said chuck operating means and said lining head moving means to effect operation of said chuck at all times while said lining head is in its operative edge-lining position, a spindle, a spindle drive, and means to control the connection of said spindle to its drive prior to placement of said lining head in its operative edge-lining position but after operation said chuck to hold ware and the disconnection of said spindle from its drive after the lining head has commenced to move from its edge-lining position but prior to operation of the chuck to release ware therefrom, said control means comprising a common cam shaft and chuck-operation, lining head movement and spindle operation cams mounted on said cam shaft, the same cams being indexed and having operative cam faces of lengths to effect, seriatim, operation of said chuck to hold ware, connection of said spindle to its drive, placement of said lining head in its edge-lining position, commencement of movement of said lining head from its lining position, disconnection of said spindle from its drive, and operation of said chuck to release ware.

5. In a ware decorating machine of the class described, a ware-holding chuck, a lining head comprising a roll to scribe a line on the edge of ware carried by said chuck, said roll having an axial length greater than the width of the line to be inscribed, means controlling the operation of said chuck to enable ware to be held on said chuck and to be released therefrom, means to move said lining head from an operative ware edge-lining position to an inoperative position, and means controlling the operation of said chuck operating means and said lining head moving means to effect operation of said chuck at all times while said lining head is in its operative edge-lining position, a spindle, a spindle drive, and means to control the connection of said spindle to its drive prior to placement of said lining head in its operative edge-lining position but after operation said chuck to hold ware and the disconnection of said spindle from its drive after the lining head has commenced to move from its edge-lining position but prior to operation of the chuck to release ware therefrom, a centering device movable toward and away from a position to center ware on said chuck, and means to control the placement of said centering device at its ware-centering position only while said spindle is disconnected from its drive.

6. In a ware decorating machine of the class described, a ware-holding chuck, a lining head comprising a roll to scribe a line on the edge of ware carried by said chuck, said roll having an axial length greater than the width of the line to be inscribed, means controlling the operation of said chuck to enable ware to be held on said chuck and to be released therefrom, means to move said lining head from an operative ware edge-lining position to an inoperative position, and means controlling the operation of said chuck operating means and said lining head moving means to effect operation of said chuck at all times while said lining head is in its operative edge-ling position, a spindle, a spindle drive, and means to control the connection of said spindle to its drive prior to placement of said lining head in its operative edge-lining position but after operation of said chuck to hold ware and the disconnection of said spindle from its drive after the lining head has commenced to move from its edge-ling position but prior to operation of the chuck to release ware therefrom, a centering device movable toward and away from a position to center ware on said chuck, and means to control the placement of said centering device at its ware-centering position only while said spindle is disconnected from its drive, said control means comprising a common cam shaft and chuck, lining head, spindle, and centering device operating cams, said cams being indexed on said cam shaft and having operative cam faces of lengths to effect, seriatim, the operation of said chuck to hold ware, connection of said spindle to its drive, placement of said lining head in its edge-lining position, commencement of movement of said lining head from its edge-lining position, disconnection of said spindle from its drive, and operation of said chuck to release ware and placement of said centering device in its centering position only while said spindle is disconnected from its drive.

7. In a machine for lining the edge of dishware and the like, a chuck; a first drive means for said chuck; a lining head comprising a color-carrying lining roll having an axial length greater than the width of the line to be inscribed and adapted to contact the edge of ware carried by said chuck, means to support said roll in floating contact with such ware, second positive drive means to drive said roll continuously and positively during such contact, and means to supply color to said roll, and means to distribute said color over said roll while said roll is in such contact, means to support said lining head adjacent said chuck, means to vary the radial distance between said chuck and said lining roll, means to vary the vertical height of said lining roll with respect to said chuck, and means to vary the angle at which said lining roll contacts the edge of ware carried by said chuck, whereby the machine may be set to line ware of varying sizes and the location of the line on the edge of the ware may be varied; and means to equalize the peripheral speed of said lining rool and the average peripheral speed of ware of a given size carried by said chuck, a vacuum cup carried by said chuck and adapted to engage ware placed therein, a source of vacuum, a line from said source of vacuum communicating with the interior of said vacuum cup, and a valve in said vacuum line to open said line from said vacuum cup to said source, whereby ware placed in said chuck will be held thereon, and to

close said line, whereby said ware will be released, means to center said ware on said chuck, means to raise said lining head from a position contacting ware carried by said chuck to a position out of contact with the ware, and means to time the operation of said vacuum valve, centering means, and lining head raising means during a cycle of operation to lower said lining head into contact with the ware while the vacuum line is open and to center ware on said chuck while said head is out of contact with said ware.

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