

May 29, 1962

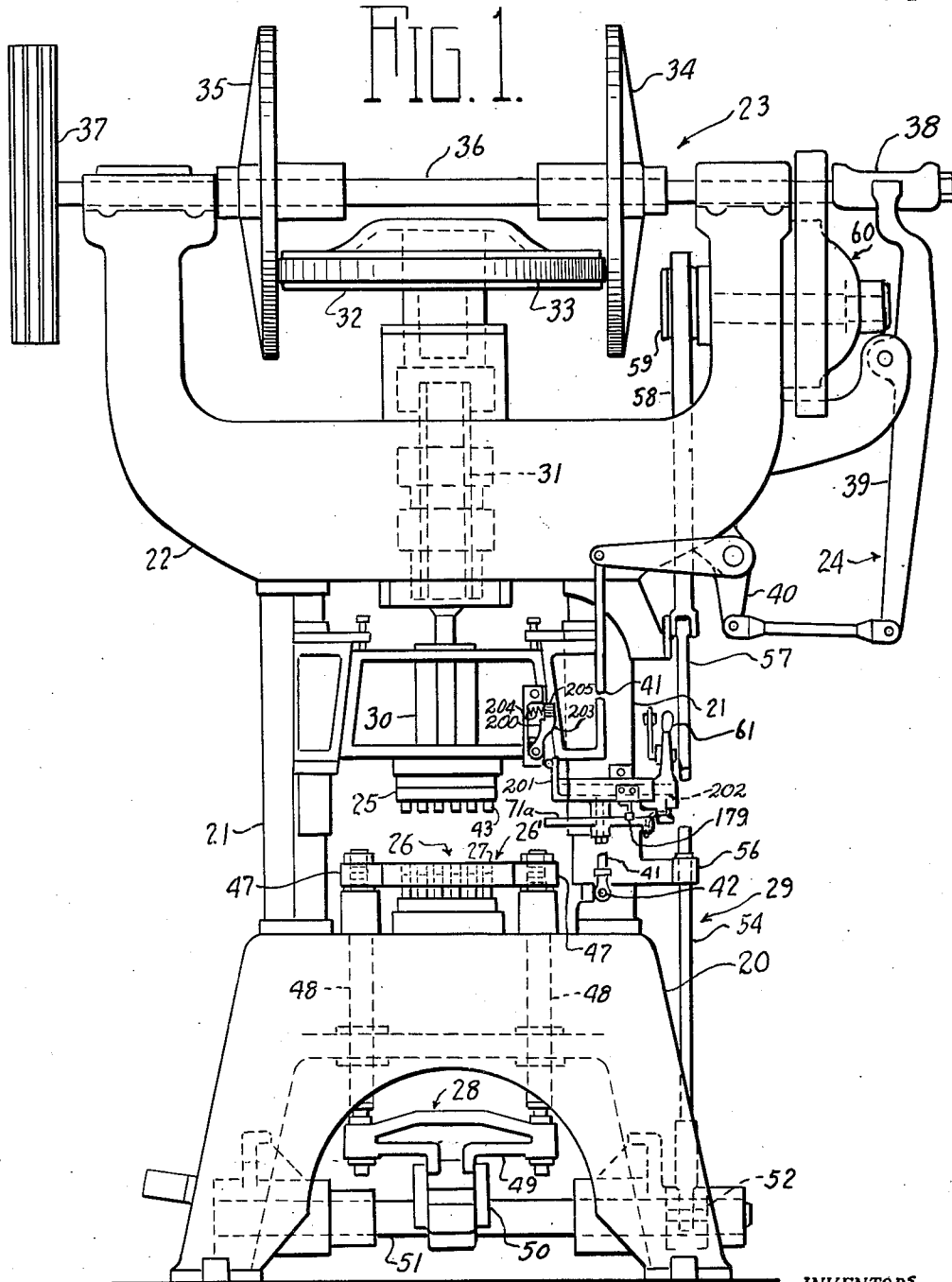
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3,036,355

APPARATUS FOR HANDLING CERAMIC GREEN GOODS

Filed June 29, 1959

9 Sheets-Sheet 1



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9 Sheets-Sheet 2

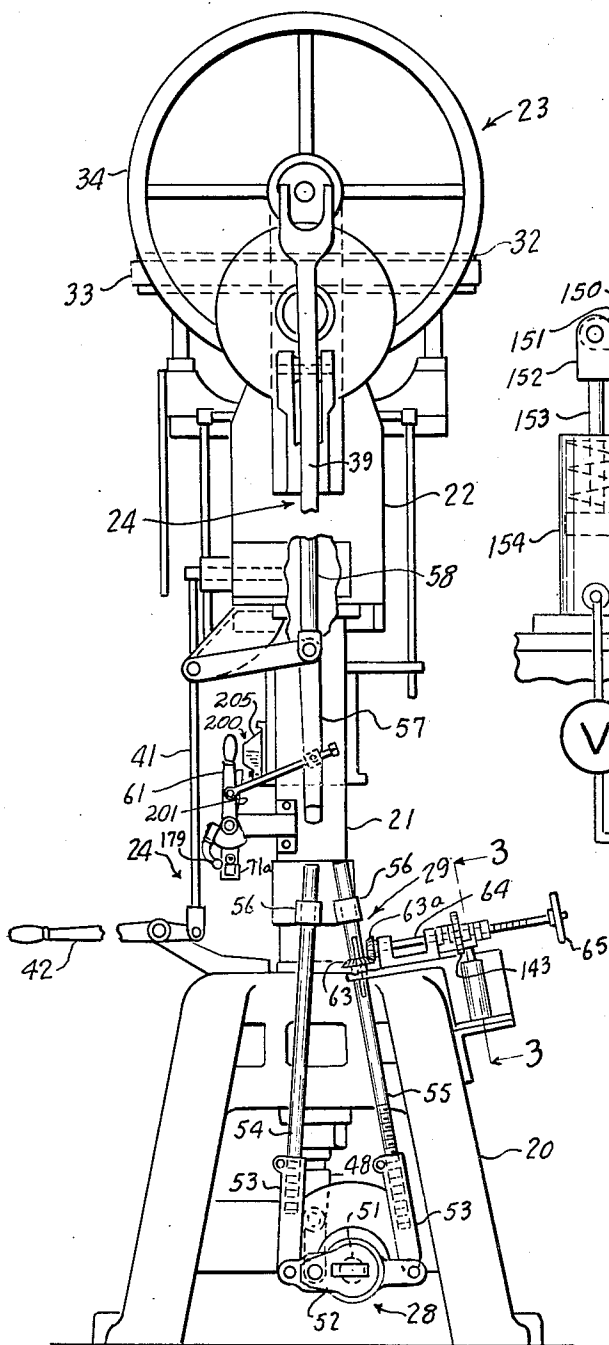
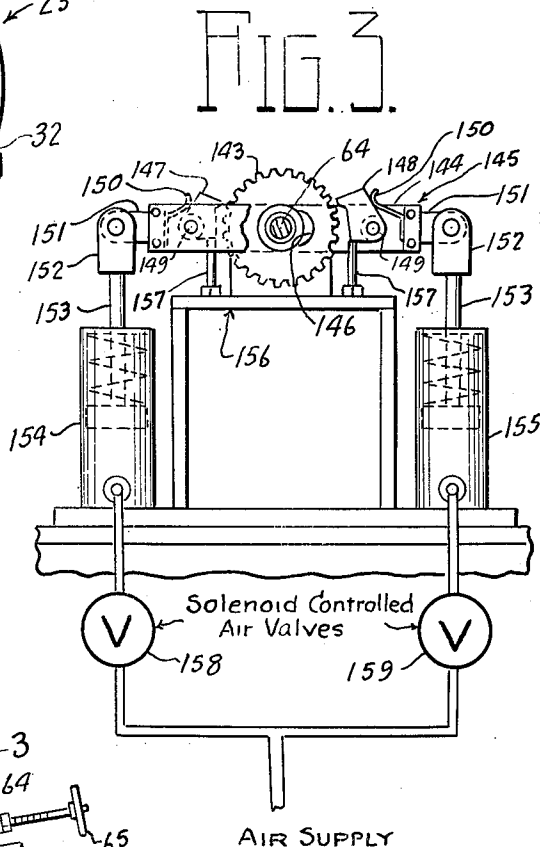


FIG. 2.



AIR SUPPLY

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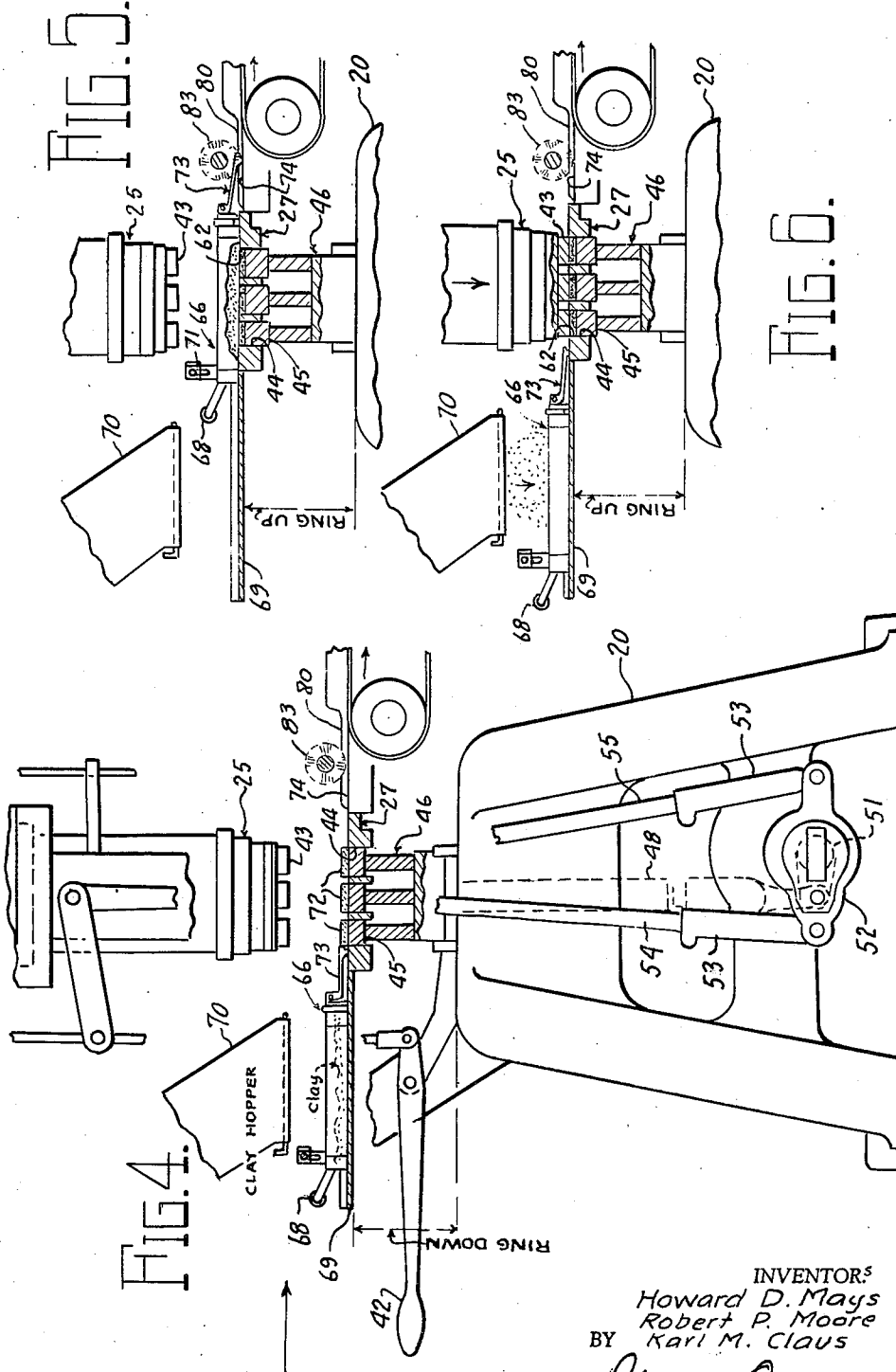
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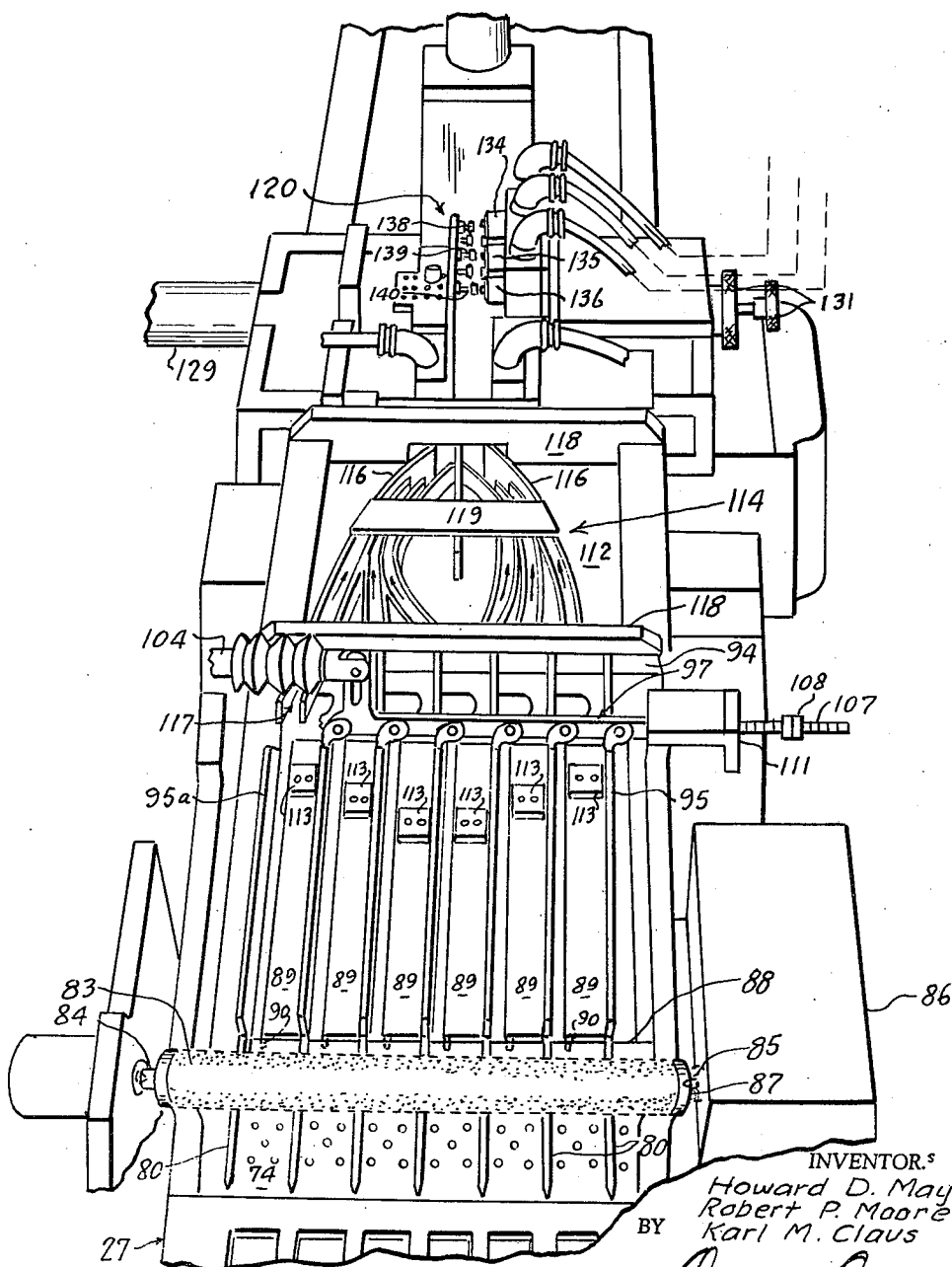
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FIG. 7.



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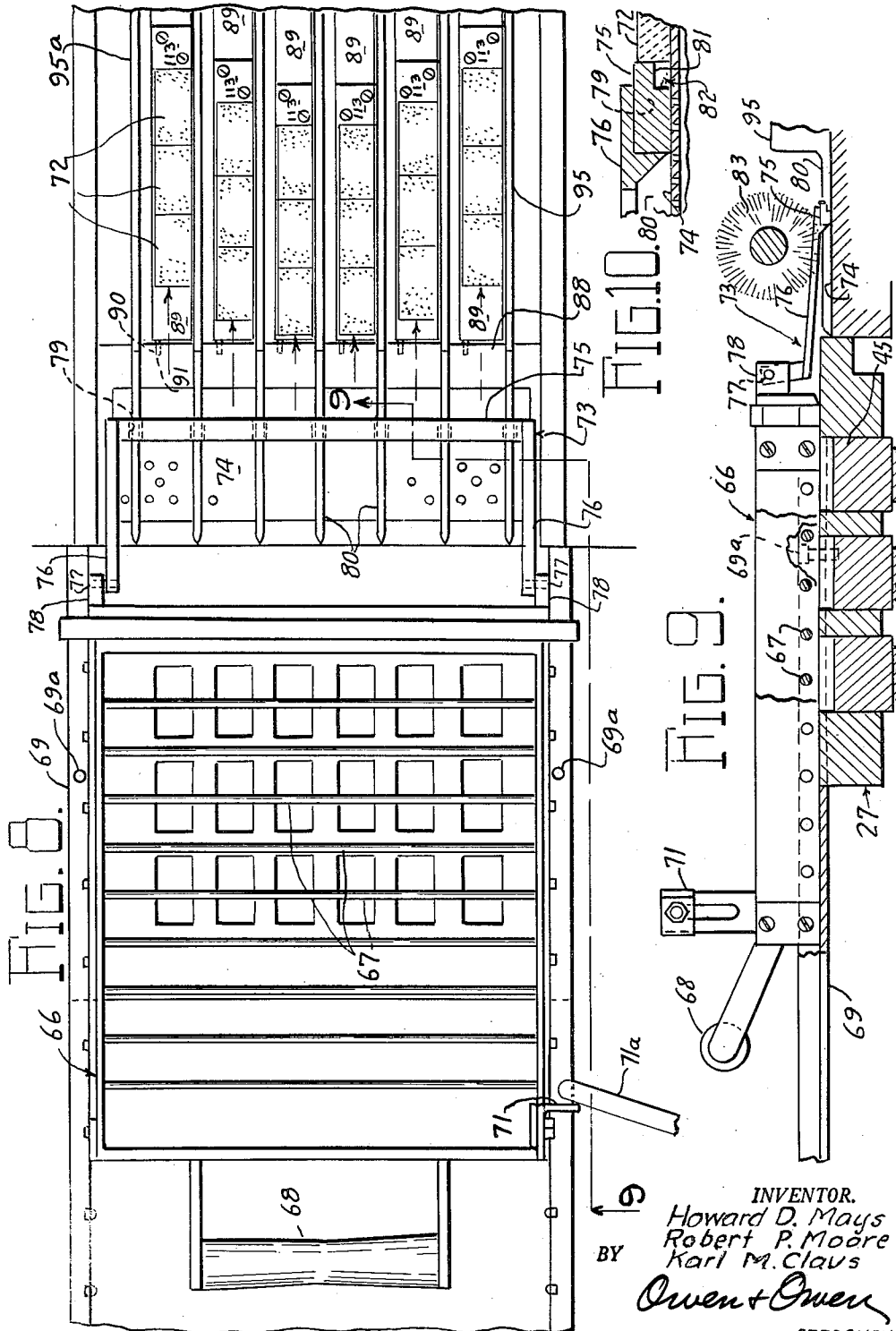
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FIG. 11.

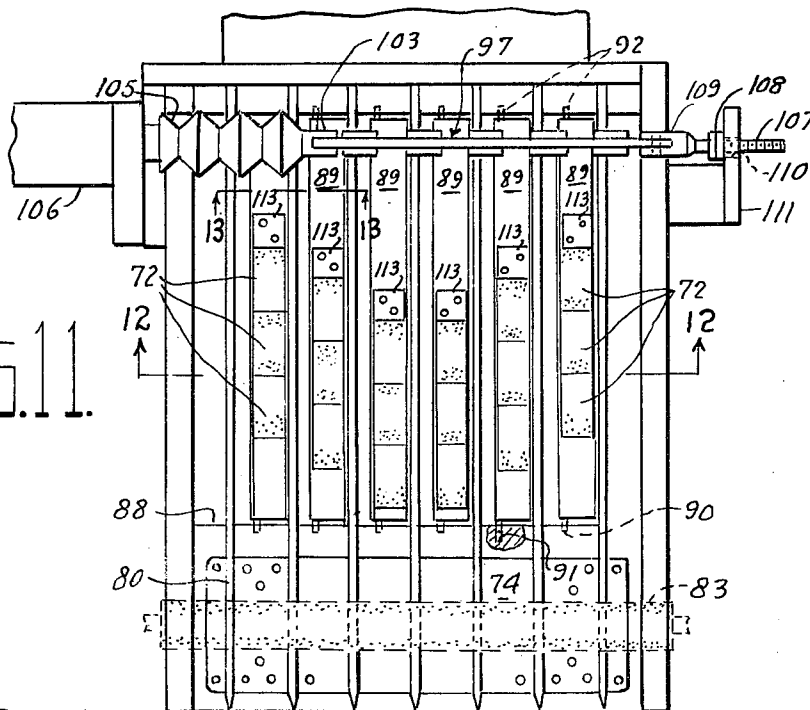


FIG. 12.

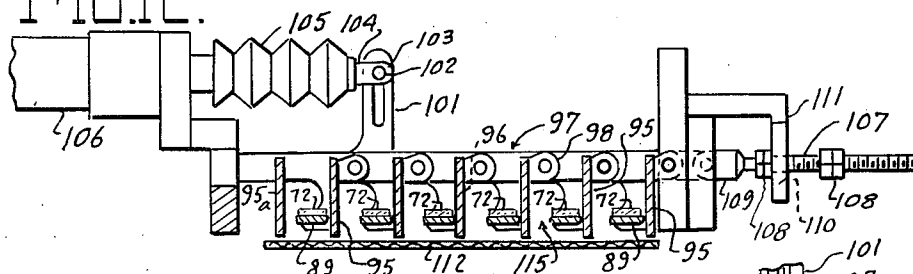


FIG. 13.

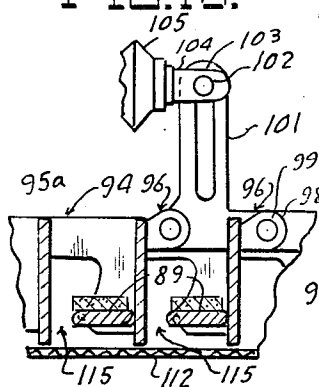
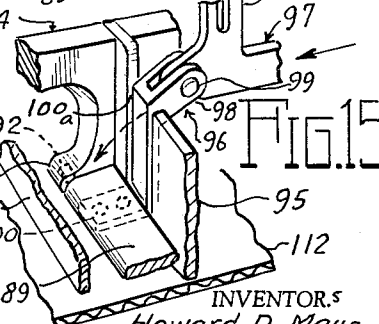
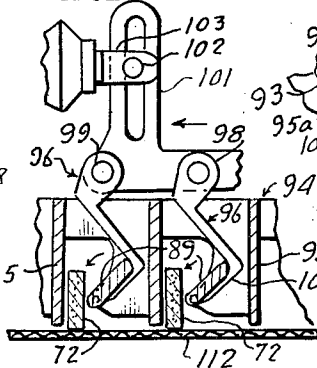


FIG. 14.



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FIG. 16.

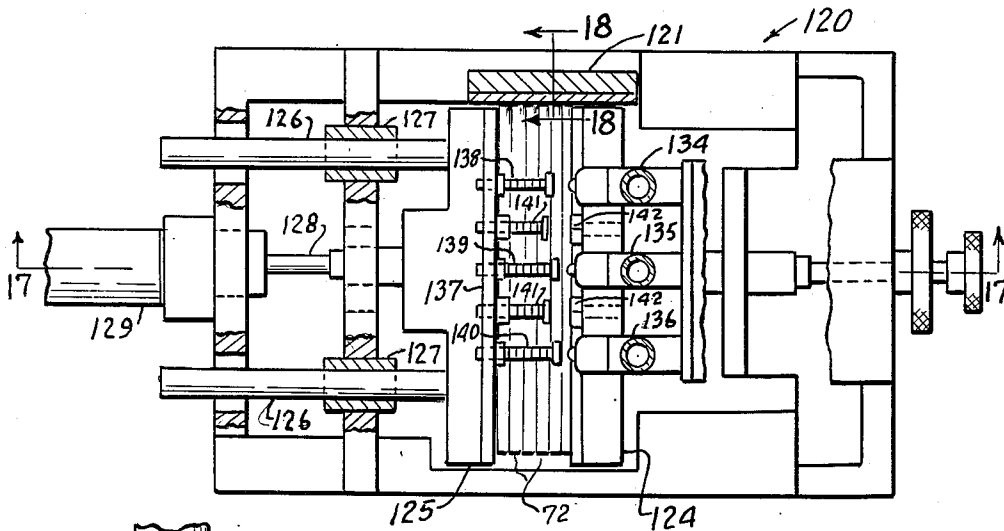


FIG. 18.

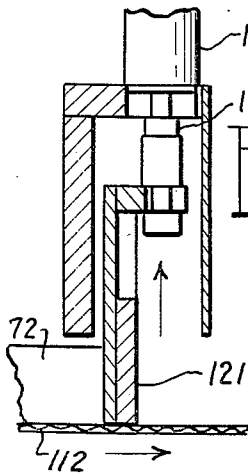
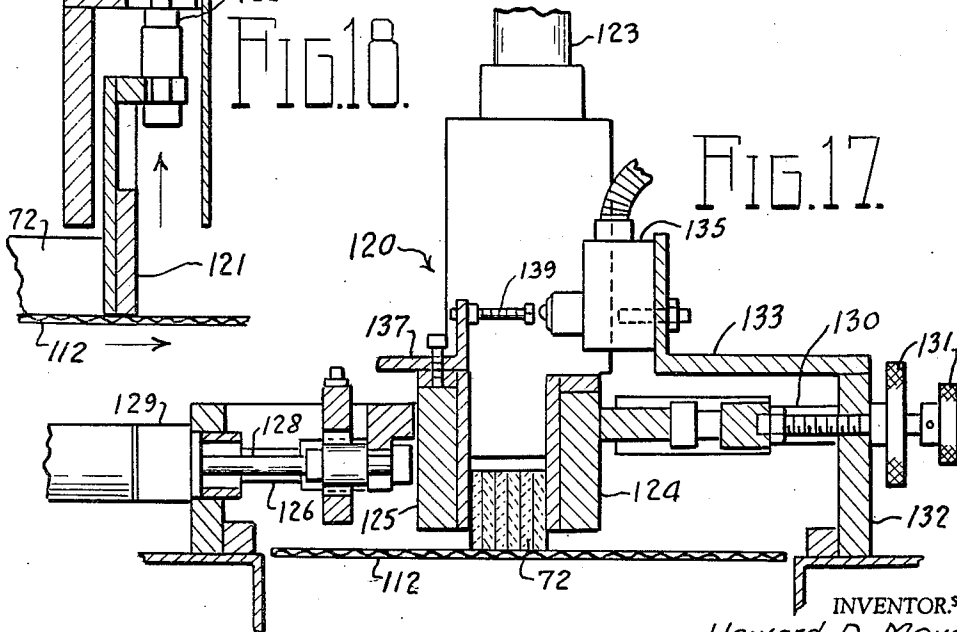


FIG. 17.



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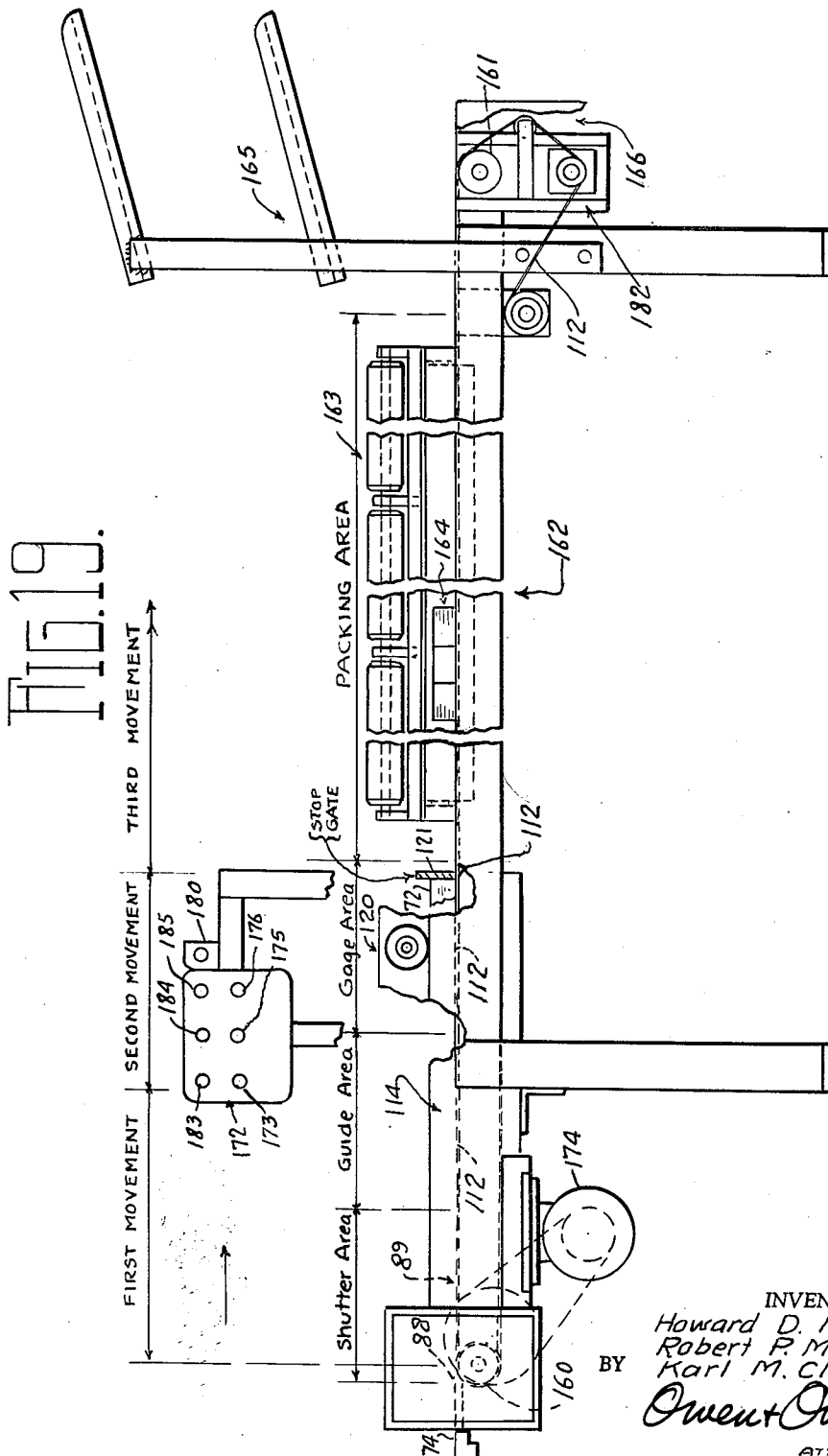
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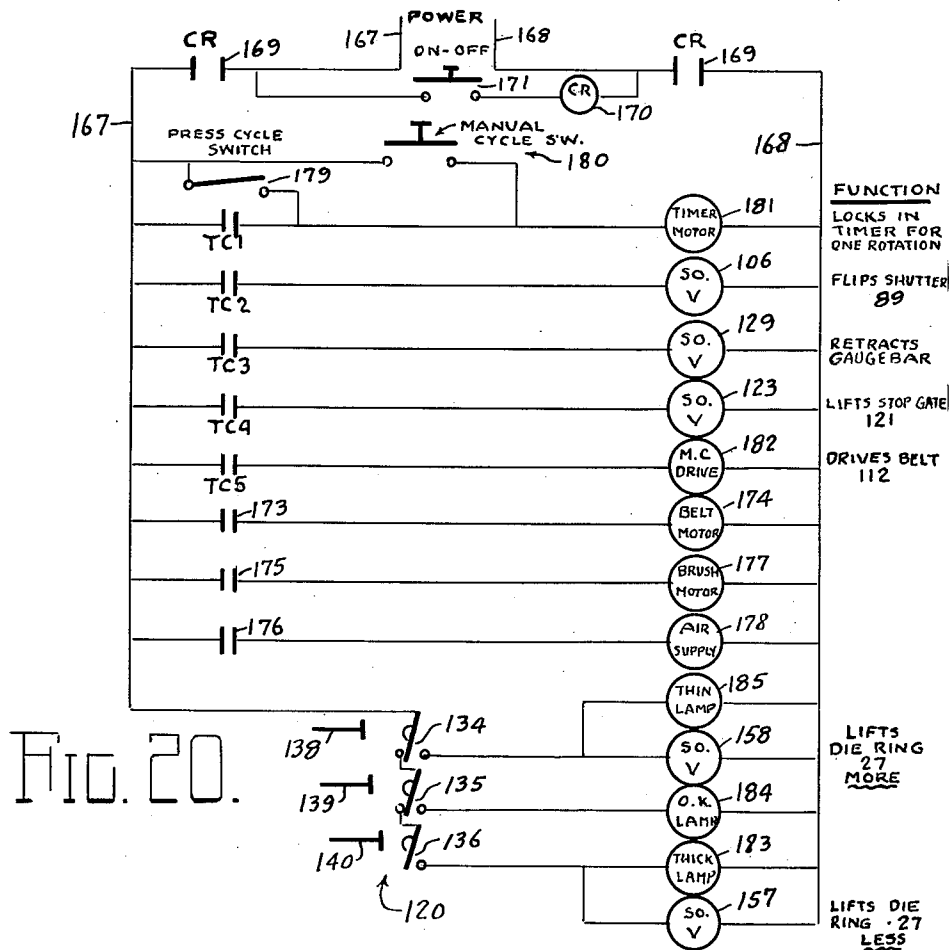


FIG. 20.

TIMER ROTATION					
CONTACTS	CAM	0°	90°	180°	270° 360°
TC-1	TIMER	[Solid line]			
TC-2	TURN-OVER	[Pulse]			
TC-3	GAUGE	[Solid line]			
TC-4	STOP-GATE	[Solid line]			
TC-5	BELT CLUTCH	[Solid line]			

FIG. 21.

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3,036,355 APPARATUS FOR HANDLING CERAMIC GREEN GOODS

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Filed June 29, 1959, Ser. No. 823,412
7 Claims. (Cl. 25—45)

This invention relates to an apparatus for handling compressed bodies for ceramic tiles, called "green goods," and more particularly to apparatus for use with a green goods forming press, which apparatus handles the goods with little or no damage, cleans them of loose dust, associates them in groups, gauges their thickness and automatically adjusts the press so that the thickness of subsequently pressed green goods will be held within established tolerance.

Green goods for ceramic tiles are compressed in molds from finely ground mixtures of materials which are suitable for firing to form ceramics, usually a considerable number being formed in each closure of the press. It has been conventional in the ceramic industry for the pressed green goods to be ejected into a "book," dusted by hand, and stacked in a gauge. After the operator has stacked up several "books" of green goods, he observes the total height relative to a line on the gauge. If the pile is higher or lower than the gauge line, he operates a manual control to change the press setting so that subsequent green goods are either thicker or thinner, depending upon the error which has crept into the operation. Because it is necessary to accumulate quite a pile of green goods before the total of all the errors can be visually judged against a gauge line, as many as four or five pressings must be finished before any adjustment can be made. It is possible, therefore, that as many as, say, five groups of twenty items each will be outside of thickness tolerance before the press can be compensatorily adjusted. It is also possible, of course, that after stacking four or five successive pressings, the errors may offset each other and the fact that the green goods are out of tolerance may pass completely unobserved.

It is the principal object of this invention, therefore, to provide automatic means for receiving the green goods after they are pressed, for transferring them into gauging means and for automatically assembling the green goods from a single pressing in a stacked array so that the error in the thickness of a single pressing is multiplied and can be sensed for adjusting the press to restore subsequent pressings to within tolerance.

It is another object of the instant invention to provide apparatus which handles relatively frangible, ceramic green goods with very small likelihood of breakage, and which handles the green goods on edge rather than flat, thereby reducing the area of surface upon which dust or foreign matter can accumulate and greatly reducing the number of finished ceramic tiles which are discolored by reason of such foreign matter.

It is yet another object of the instant invention to provide an apparatus for receiving pressed green goods from a press, arraying the green goods in compact groups on their edges, gauging the thickness of a number of the individual green goods from a single pressing, compensatorily adjusting the press for errors in thickness thereof and delivering the green goods to a packing station in groups suitable for placement in kiln furniture.

These and other more specific objects and advantages of the instant invention will be apparent from the fol-

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lowing detailed description and from the drawings, in which—

FIG. 1 is a simplified front view in elevation of a ceramic green goods press of one of the types with which apparatus embodying the instant invention is designed to be employed;

FIG. 2 is a simplified view in side elevation of the press shown in FIG. 1 as equipped with thickness adjusting means actuated by apparatus embodying the instant invention;

FIG. 3 is a vertical sectional view taken along the line 3—3 and shown on an enlarged scale;

FIG. 4 is a fragmentary, somewhat diagrammatic view, with parts shown in section, taken through the mold portion of the press such as that shown in FIGS. 1 and 2, and illustrating the manner of pressing the green goods and delivering the green goods from the press to apparatus embodying the invention;

FIG. 5 is a fragmentary view similar to FIG. 4, but showing a lesser portion of the mechanism and illustrating relative positions of the parts at a stage subsequent to that shown in FIG. 4;

FIG. 6 is a view similar to FIG. 5 and illustrating the parts at a still subsequent stage;

FIG. 7 is a fragmentary view in perspective taken from the output side of the press shown in FIGS. 1 and 2, and illustrating apparatus embodying the invention;

FIG. 8 is a fragmentary plan view on an enlarged scale showing means for feeding powdered clay to the press and for delivering the pressed green goods from the press to the entry side of apparatus embodying the invention;

FIG. 9 is a fragmentary, vertical, sectional view, with parts broken away, taken from the position indicated by the line 9—9 of FIG. 8;

FIG. 10 is a fragmentary detailed view in vertical section of a portion of the mechanism shown in FIG. 9;

FIG. 11 is a fragmentary plan view of the entry portion of apparatus embodying the invention and in particular showing mechanism whereby the pressed green goods are turned up on edge shortly after delivery to the apparatus;

FIG. 12 is a fragmentary, vertically, sectional view taken along the line 12—12 of FIG. 11;

FIG. 13 is a fragmentary, vertical, sectional view on an enlarged scale taken along the line 13—13 of FIG. 11;

FIG. 14 is a view similar to FIG. 13 but showing the apparatus in a different position;

FIG. 15 is a fragmentary view in perspective of a portion of the mechanism illustrated in FIGS. 13 and 14 and shown in position of FIG. 13;

FIG. 16 is a fragmentary plan view, with parts shown in section and parts broken away, of a form of thickness gauging means constituting a principal part of apparatus embodying the invention;

FIG. 17 is a vertical, sectional view on an enlarged scale taken generally along the line 17—17 of FIG. 16;

FIG. 18 is a fragmentary, vertical, sectional view taken on the line 18—18 of FIG. 16 and shown on an enlarged scale;

FIG. 19 is a diagrammatic view in side elevation of apparatus embodying the invention and illustrating the cycles of movement of the apparatus as operated according to the invention to carry out its function;

FIG. 20 is a simplified wiring diagram illustrating the cycling and control of apparatus embodying the invention, and

FIG. 21 is a diagrammatic view of timer control cams used with the electrical apparatus of FIG. 20 to control the cycling of the apparatus.

While apparatus embodying the invention does not include within its scope the particular press upon which powdered materials are compressed to form ceramic green goods, in order for the function and operation of apparatus embodying the invention to be understood, the operation of a typical ceramic green goods press such as the press shown in FIGS. 1 and 2 and fragmentarily in FIGS. 5-7, inclusive, must be explained. The press itself is old in the art and it is not intended to be included within the scope of the present inventive concepts.

A typical ceramic green goods press as illustrated in FIGS. 1 and 2 comprises a base 20, columns 21, a drive yoke 22, a reversible drive mechanism generally indicated at 23, drive control leverage generally indicated at 24, an upper die 25, a lower die generally indicated at 26 and including a die ring 27, ring lifting mechanism generally indicated at 28, and ring lift control mechanism (see also FIG. 2) generally indicated at 29.

The upper die 25 is rigidly mounted on the lower end of a slide 30 which is in turn secured to the lower end of a screw 31 engaged in steep pitched, large-size threads formed on the interior of a vertical bore in the base of the drive yoke 22. The upper end of the screw 31 is keyed or otherwise rigidly secured to a bull wheel 32 having a friction tire 33. The bull wheel 32 and its tire 33 are alternatively engaged by each of a pair of constantly running clutch discs 34 and 35. The clutch discs 34 and 35 are secured on a horizontal drive shaft 36 driven by a sheave 37 and rotatably mounted in journals in the upper ends of the arms of the drive yoke 22. The two clutch discs 34 and 35 and their drive shaft 36 are longitudinally shiftable to alternately bring the clutch discs 34 and 35 into engagement with the bull wheel 32, by a shifting yoke 38 secured to the upper end of a rocking lever 39 and through a bell crank linkage 40 to a pull rod 41, to the lower end of which there is connected a hand lever 42 (see also FIG. 2).

When an operator moves the hand lever 42 downwardly, it thrusts the pull rod 41 upwardly and through the bell crank linkage 40, and lever 39 pulls the drive shaft 36 to the right (FIG. 1) engaging the clutch disc 35 with the bull wheel 32. Similarly, upward movement of the hand lever 42 reverses this movement to shift the clutch disc 34 into engagement with the bull wheel 32. Depending upon the direction of rotation of the sheave 37, shaft 36 and clutch discs 34, 35, these movements of the hand lever 42 rotate the bull wheel 32 either to the right or to the left, the opposing movements either serving to rotate the screw 31 to lower the slide 30 and upper die 25 or to lift the slide 30 and the upper die 25. Movement of the hand lever 42 causes the press to close and reverse movement thereof causes the press to open.

Die Construction

The upper die 25 (see also FIGS. 5, 6, 7) includes a plurality of individual die punches 43. In the press illustratively shown in the drawings, the upper die 25 is shown as having six rows of three each of the punches 43. Similarly, the die ring 27 has six lateral rows of three pockets 44 each, the pockets 44 in the die ring 27 being vertically aligned with the punches 43 on the upper die 25. The pockets 44 in the die ring 27 are bottomed by lower punches 45 which are rigidly mounted on a bridge structure 46 immovably supported on the base 20. There are, of course, a similar number of lower punches 45 aligned with the upper punches 43 and filling the pockets 44 for which they serve as bottoms.

The upper die 25, die ring 27 and lower punches 45 constitute a set designed to produce a certain number of pressed green goods of certain size. Other sets having different numbers of punches and pockets of different sizes are mountable in the press. The particular set shown in the drawings is illustrative only and is designed to press

eighteen pieces 1" wide x 2" long x 1/4" thick as is shown in FIGS. 8 and 11.

The die ring 27 is a grid having a pair of laterally extending ears 47 (FIG. 1) by which the ring 27 is mounted on the upper ends of a pair of support rods 48 that are guided for vertical sliding movement in the base 20. The support rods 48 are yoked together by a stirrup 49 which is pivotally connected to a crank 50 mounted on a rocker shaft 51 in the base 20. A rocker 52 (see FIGS. 1 and 4) is secured on one end of the rocker shaft 51 and a pair of upwardly extending turnbuckles 53 are pivotally connected at their lower ends to the rocker 52.

Two thrust rods 54 and 55, respectively (see FIG. 2), are threaded into the open upper ends of the turnbuckles 53 and guided for sliding movement by a pair of pivoted guides 56 mounted on the side of one of the columns 21.

A plunger 57 (FIGS. 1 and 2) is mounted for vertical reciprocatory movement at the side of one of the columns 21 and is linked to the lower end of a connecting rod 58 vertically reciprocated by an eccentric 59 which is in turn driven by a constantly rotating drive generally indicated at 60 which is supported at the upper end of one arm of the drive yoke 22. The plunger 57 constantly reciprocates along a path determined by the setting of its control lever 61. When the control lever 61 is in the position indicated in FIGURE 2, the plunger 57 is aligned with the upper end of the thrust rod 54 so that during its downward movement it engages the upper end of the thrust rod 54 to rotate the rocker 52 in a counterclockwise direction to the position shown in FIG. 2 and through the crank 50 and yoke 28 to lower the die ring 27 to its lowermost position. This lowermost position is illustrated in FIG. 4 and results in the ring 27 being positioned so that the tops of the lower punches 45 are level with the upper surface of the ring 27.

When the control lever 61 is set in its second position, i.e., swung in a clockwise direction (FIG. 2), the plunger 57 is aligned with the end of the thrust rod 55. Therefore, during the downward stroke of the plunger 57 it engages the upper end of the thrust rod 55 to rock the rocker 52 and, through the crank 50, to thrust the support rods 48 upwardly and to lift the die ring 27 to its upper position (shown in FIGS. 5 and 6), lifting its upper surface above the level of the top of the lower die punches 45 and forming pockets 62 above the punches 45 for the reception of finely ground material to be compressed into green goods.

The depth of the pockets 62 above the lower die punches 45 may be varied by adjusting the stroke of the thrust rod 55. As can be seen by reference to FIG. 2, the thrust rod 55 is threaded into the open socket at the upper end of the turnbuckle 53 and is splined in a bevel gear 63 which is meshed with a similar bevel gear 63a pinned on the inner end of an adjustment shaft 64. A hand wheel 65 is secured on the outer end of the shaft

64. By rotating the shaft 64, the bevel gears 63a and 63 are rotated and the thrust rod 55 threaded into or out of its turnbuckle 53. When it is desired to make the compressed green goods thicker, the rod 55 is turned out of the turnbuckle 53 to increase its effective length so that the fixed stroke of the plunger 57 thrusts the rod 55 farther and, through the rocker 52 and crank 50, lifts the support rod 48 and die ring 27 to a higher level. Conversely, if it is desired to make the compressed green goods thinner, reverse rotation of the shaft 64 results in "shortening" the rod 55 and the die ring 27 is lifted less on the next stroke of the plunger 57. In further discussion, it will be assumed that rotation of the shaft 64 in a clockwise direction lengthens the rod 55, and vice versa.

The manner in which the apparatus embodying the invention functions to make adjustments in the height to which the die ring 27 is lifted and, therefore, in the thickness of the green goods, as determined by measurement of a previously pressed group of green goods, will

be described below in the section entitled "Press Adjustment."

Powdered Ceramic Material Feeding

A press of the type with which apparatus embodying the invention is designed to be employed has means for feeding powdered material from a supply and into the pockets 62. In the press illustratively shown in the drawings, this means includes a shaker box 66 shown in FIGS. 8-10 and in use in FIGS. 4-6. The shaker box 66 (FIGS. 8-10) is an open frame having a plurality of cross tie rods 67 for rigidity, the rods 67 also serving to break up densified portions of the finely powdered material to prevent bridging across the openings in the die ring 27. The shaker box 66 has an operator's handle 68 at its rear side by which it is moved back and forth on a support tray 69. The support tray 69 is rigidly bolted to the die ring 27 by bolts 69a so that the surface of the tray 69 and thus the bottom of the shaker box 66 always remains at the level of the upper surface of the die ring 27. The shaker box 66 moves up and down with the die ring 27 relative to the lower punches 45. The die ring 27, tray 69 and shaker box 66 are shown in their upper positions in FIG. 9 where the shaker box is shown near its innermost position.

The operator loads the shaker box 66 by moving it rearwardly to the position shown in FIG. 4, beneath a material hopper fragmentarily indicated at 70. The operator discharges a quantity of powdered material from the hopper 70 into the shaker box 66 and then slides the shaker box from the position shown in FIG. 4 to the position shown in FIG. 5. As he moves the shaker box 66 inwardly, the arm of a striker 71 on the side of the shaker box 66 engages the end of a horizontal lever 71a (FIGS. 1 and 8) which swings horizontally and, at its outer end is linked to the lower end of the control lever 61 to shift the lever 61 to the position where the plunger 57 hits the end of the thrust rod 55 to elevate the die ring 27 to the position shown in FIG. 5. The operator shakes the shaker box 66 (FIG. 5), causing the powdered material to fall downwardly into the pockets 62 above the lower punches 45. He then pulls the shaker box 66 back to the position shown in FIG. 6, and actuates the hand lever 42 to cause the press to close and move the upper die 25 downwardly inserting the upper punches 43 into the top of the pockets 62 and compressing the powdered material between the upper punches 43 and lower punches 45 to densify the material and form the green goods.

As the press slide 30 moves downwardly, a cam 200 (FIG. 1) engages an arm 201 on the end of a shaft 202 on the other end of which the lever 61 is mounted. The cam 200 is pivoted at its lower end and has a curved cam surface 203 on its outer side. Because the lever 61 and thus the arm 201 are at their inner position (to the right in FIG. 2), they cannot swing farther so the arm 201 swings the cam 200 in a clockwise direction. After the cam 200 has passed the arm 201, a spring 204 swings the cam back to the position illustrated in FIG. 1 but beneath the arm 201.

After the press closes, the operator actuates the lever 42 to open the press. During the upward movement of the slide 30, an inclined surface 205 (FIG. 2) on the upper front face of the cam 200 engages beneath the end of the arm 201 and swings it forwardly, restoring the lever 61 to the position shown in FIG. 2 and realigning the plunger 57 with the thrust rod 54 to lower the die ring, leaving the compressed green goods indicated at 72 in FIG. 4 on the upper ends of the lower punches and at the level of the upper surface of the die ring 27.

Ejection of Compressed Green Goods

As can be seen in FIGS. 4-10, the compressed green goods 72 are left on the upper ends of the lower punches 45 when the die ring 27 and the shaker box tray 69 are lowered after a pressing cycle. When the operator next moves the shaker box 66 into the press for the purpose of

providing a supply of powdered clay for the next pressing, a pusher bar, generally indicated at 73 (FIG. 9), engages the back side of the first row of previously pressed green goods 72 and pushes them off of the upper ends of the lower punches 45 across the die ring 27 of the press onto a perforated apron 74 leading to turn-up and thickness gauging mechanisms.

The pusher bar 73 comprises a cross bar 75 and a pair of swinging arms 76 which are pivoted by pins 77 in a pair of forwardly extending ears 78 at the sides of the front of the shaker box 66. The arms 76 are so shaped that the force of gravity acting on the pusher bar 73 holds it down behind the green goods 72 which it is ejecting from the press. The cross bar 75 of the pusher bar 73 has a plurality of grooves 79 in its under surface which are aligned with and slide over thinner parts of parallel, spaced guides 80 on the perforated apron 74. The cross bar 75 (see FIG. 10) has a transversely extending rabbit 81 in its leading edge so that any of the powdered material, dust or other particles which may fall off of the green goods 72, or otherwise accumulate on the smooth upper surface of the apron 74, are scraped off the apron 74 (as indicated by the reference number 82) and pushed along on the apron 74 to be carried downwardly through the perforations in the apron 74 and removed from the machine. The cross bar 75 has a diagonally cut rear edge so that it will rid up over the front edge of the die ring 27 in its raised position (FIGS. 5, 6 and 9) during withdrawal of the shaker box 66 from the press.

During the movement of the green goods 72 onto the perforated apron 74, they are moved under a constantly rotating brush 83. The brush 83 (see also FIG. 7) is mounted by a pair of opposed arbors 84 and 85 with its axis lying horizontally across and above the perforated apron 74. The brush 83 is driven at high constant speed by a motor and drive gear enclosed within a drive housing 86 by a drive dog 87 on the arbor 85. The brush 83 is rotated contra to the direction of movement of the green goods 72 to effectively dust their upper surfaces, the dust removed thereby being carried away by a suction draft flowing through the perforations in the apron 74 to a vacuum chamber beneath the machine. A dust collector hood usually is also positioned above the brush 83 but is not shown in the drawings since it does not per se constitute a part of the invention and would obscure some of the views.

Turn-Up Mechanism

The perforated apron 74 extends forwardly and its far edge 88 is adjacent to and lies in the same horizontal plane as the rear edges of a plurality of shutters 89. In the modification of the invention shown in the drawings, there are six shutters 89 corresponding to the six rows of three each of pockets 44 in the die ring 27. Each of the shutters 89 is pivoted at its front edge by a pin 90 extending into a socket 91 drilled in the forward edge 88 of the apron 74. The far ends of the shutters 89 are similarly mounted by pins 92 (FIGS. 11 and 15) in ears 93 on a back wall 94. The shutters form the bottoms of a plurality of parallel, longitudinally extending channels the sides of which are formed by higher extensions 95 of the guides 80. The far ends of the extensions 95 are mortised into the top and front sides of the back wall 94, being supported by the back wall 94 at their far ends and by the apron 74 at their front ends.

Each of the shutters 89 is connected by a link 96 to a transversely extending slide 97, the links 96 having bifurcated ears 98 which embrace the slide 97 and are pivotally connected to the slide 97 by pivot pins 99. Each of the links 96 also has a turned under arm 100 which extends beneath and is bolted to its respective shutter 89. The vertical arm of each of the links 96 lies in and swings through a slot 100a (FIG. 15) in the adjacent guide extension 95. (The guide extension 95a at the

left side of the shutter turn-up mechanism does not have such a slot.) The slide 97 has an upstanding slotted arm 101 through which extends a pin 102 of a clevis 103. The clevis 103 is mounted at the end of an actuating rod 104 which extends through a bellows 105 and is connected to the piston of an air cylinder 106. A threaded stop rod 107 having stop nuts 108 thereon is connected to the end of the slide 97 by a clevis and pin 109 and extends horizontally through a vertical slot 110 in a stop plate 111.

A conveyor belt 112 comes up from beneath the far edge 88 of the perforated apron 74 and runs along underneath the shutters 89, the extensions 95 of the guides 80 and the end plate 94.

Each of the shutters 89 has a stop 113 riveted on its upper face near its far end. The stops 113 (FIGS. 7 and 11) are spaced along their respective shutters 89 at different distances from the perforated apron 74, those at the center being closest to the apron 74 and those at the outer sides being farthest removed therefrom. The purpose of the spacing of the stops 113 longitudinally on the shutters 89 will be better understood with reference to the section of this specification below dealing with the converging guide generally indicated at 114 in FIG. 7.

As described above, the green goods 72 are pushed over the apron 74 by the pusher bar 73 and onto the shutters 89 in their horizontal positions when the operator moves the shaker box 66 into the press. The surfaces of the perforated plate 74 and shutters 89 are highly polished so that when the operator shoves the shaker box 66 into the press and ejects the pressed green goods 72 out of the press, the momentum imparted to the green goods 72 by this movement of the shaker box 66 causes them to slide on the surfaces of the shutters 89 until they strike the stops 113. A pressing of green goods 72 is shown in this position in FIGS. 8 and 11.

By means of the timing mechanism which controls the operation of apparatus embodying the invention (which will be described below with reference to FIGS. 20 and 21), the air cylinder 106 is energized shortly after a pressing of green goods has been ejected into the position of FIGS. 8 and 11. Actuation of the air cylinder 106 draws its rod 104 inwardly (to the left FIGS. 7 and 11-15) and through the clevis 103 pulls on the arm 101 to shift the slide 97 to the left. Through the links 96, the shutters 89 are all tilted to the left, i.e., from the position of FIG. 13 to the position of FIG. 14. Tilting the shutters 89 in this manner tips the green goods 72 off of the shutters 89 and stands them on edge on the belt 112 adjacent the respective ones of the guide extensions 95. The stroke of the slide 97, and thus the angle of tilt of the shutters 89, is controlled by the stop nuts 108 on the stop rod 107. Because the slide 97 translates upwardly during this movement, rather than sliding horizontally, the arm 101 must be provided with a vertically elongated slot for the pin 102 and the stop plate 111 has a vertical slot 110.

During the immediately following movement of the belt 112, as will be described below, the green goods 72 now standing on edge as in FIG. 14 are moved forwardly out of the channels between the guide extensions 95 through openings in the end wall 94 generally indicated by the arrows 115 in FIGS. 12 and 13.

By turning the green goods 72 up on edge immediately after they are dusted by the brush 83, much less area is presented for the reception of air-borne foreign matter or dust with a resulting important reduction in the percentage of rejected finished tile because of discoloration.

Converging Guide

The converging guide 114 comprises a plurality of curved metal walls 116 (FIG. 7) forming guide channels, for example the channel 117 at the left in FIG. 7, leading from the openings 115 through the end wall 94, and extending along above the belt 112. There are six

of the channels 117 so that the six rows of green goods are guided by the channels 117 of the converging guide 114 toward the longitudinal center of the belt 112 and the entire apparatus. Because those rows of green goods tipped up by the outermost ones of the shutters 89 must not only be moved longitudinally but also in toward the center of the machine, their total distance of travel is greater than that of the rows of green goods tipped up by the center ones of the shutters 89. Since the control of the apparatus provides for intermittent movement of the belt 112, this greater distance of necessary travel is compensated for by starting the outer rows of green goods at a more advanced position which is determined by the more forward position of the stops 113 of the outer shutters 89. Similarly, the stops 113 of the two shutters 89 which are intermediate the inner and outer shutters are staggered a distance intermediate the stops 113 on the inner and outer shutters 89. The converging guide mechanism 114 is supported in position over the belt 112 by a pair of bridging frames 118 (FIG. 7), the walls 116 also being welded to a cross plate 119.

In an apparatus designed for handling a different number of rows of green goods (for example, 9 rows of green goods only $\frac{1}{2}$ " wide), the turn-up shutter mechanism and the converging guide must be changed as well as the upper and lower punches and die ring of the press.

Thickness Gauging Mechanism

A thickness gauging mechanism, generally indicated at 120 in FIG. 7, is shown in detail in FIGS. 16-18, inclusive. As mentioned above, the belt 112 is cycled through short intermittent movements: first, to deliver a pressing of green goods from the turn-up section of the machine into the converging guide assembly 114; second, to deliver the pressing from the converging guide assembly 114 into the thickness gauging mechanism 120, and third, to deliver a pressing from the gauging mechanism 120 to a packing area (see also FIG. 19). The thickness gauging mechanism 120 includes a stop gate 121 at its far end against which the green goods 72 are moved on the belt 112 before their thickness is gauged. The gate 121 is mounted on the lower end of a piston rod 122 (FIG. 18) which extends upwardly into an air cylinder 123. During the movement of the belt 112 to carry the green goods from the converging guide 114 into the thickness gauging mechanism, the gate 121 is down in the position shown in FIG. 18 so that all of the green goods 72 are brought up against the gate 121 and against each other by an overrun of the belt 112.

In the illustrative embodiment of the invention shown in the drawings, a single pressing consists of six rows of three each of green goods 72. By the action of the shutters 89, these are turned up on edge and the six rows of three each are brought together by the converging guide 114. By thus being turned upwardly on their edges and brought laterally adjacent each other, any error in the thickness of the green goods of a single pressing is multiplied by six so that gauging the thickness of the assembled pack is six times more accurate than would be the gauging of a single thickness of the green goods.

The gauging mechanism 120 includes a movable gauge bar 125 and a stationary gauge bar 124. The movable bar 125 is mounted on the ends of a pair of parallel guide rods 126 which slide in bushings 127 and is moved toward and away from the stationary gauge bar 124 by a piston rod 128 of an air cylinder 129. The gauge bar 124 is stationary during operation of the gauging mechanism 120 but its position is adjustable relative to the stroke of the movable bar 125. The stationary bar 124 is carried on the end of an adjustable support rod 130 which includes a pair of adjustment knobs 131 for fine adjustment of the position of the bar 124. The support rod 130 is rigidly mounted by a heavy bracket 132 having an inwardly extending platform 133 at the

inner side of which three micro switches 134, 135 and 136 are located.

An angle bracket 137 is bolted to the top of the movable gauge bar 125. Three adjustable contactors 138, 139 and 140 and two adjustable stops 141 are mounted in the vertical arm of the angle bracket 137 and extend across toward the micro switches 134, 135 and 136. The contactors 138, 139 and 140 are axially aligned with the micro switches 134, 135 and 136, respectively. The two stops 141 are similarly aligned with opposing stops 142 mounted between the micro switches 134, 135 and 136 on the platform 133.

The extent of the actuators 138, 139 and 140 is exaggerated in FIGURE 16 to illustrate the fact that the actuator 140 extends farther across toward its micro switch 136 than the actuator 139. The actuator 139 similarly extends farther than the actuator 138. The stops 141 do not extend as far as the actuator 138.

After the green goods 72 have been fed between the gauge bars 124, 125 and have come to a stop against the gate 121, and the belt 112 has stopped moving, the sequence timing mechanism of the apparatus actuates the air cylinder 129. This moves the gauge bar 125 toward the stationary bar 124 (to the right in FIGS. 16 and 17). If the thickness of the green goods 72 is in excess of tolerance, this excessive thickness is multiplied by their stacking so that only the actuator 140 engages its respective micro switch 136. If the thickness of the green goods is within tolerance, the presser 125 moves a little farther and the actuator 139 also engages its micro switch 135. Similarly, if the thickness of the green goods 72 is less than tolerance, the gauge bar 125 moves still farther and the actuator 138 also engages its micro switch 134. The safety stops 141 and 142 are so spaced that in the event the green goods 72 are much less than tolerance or they are for some reason damaged and thus do not prevent excessive movement of the gauge bar 125, the safety stops 141 will engage their respective stops 142 to prevent damage to the micro switches 134, 135 and 136. Of course, the micro switches 134, 135, 136 are so constructed that each of their actuators may be pressed inwardly a distance beyond the point of closing without danger.

As will be seen by later reference to the wiring diagram shown in FIG. 20, when the micro switch 136 alone is closed a signal is established indicating that the green goods are thicker than tolerance. When the micro switches 135 and 136 are actuated, a signal is established indicating that the green goods are within tolerance. When all three of the micro switches 134, 135, 136 are actuated, a signal is established indicating that the green goods 72 are thinner than tolerance.

Press Adjustment

As explained above in the section entitled "Die Construction" and with respect to the adjustment shaft 64, the thickness of green goods in an individual pressing is controlled by varying the length of the thrust rod 55 (FIGS. 2 and 3). In apparatus embodying the invention, the adjustment shaft 64 is rotated in response to signals originating in the thickness gauging mechanism just described.

The shaft 64 carries a gear 143 near its mid point. The gear 143 is located between parallel side members 144 of an open frame 145. The side members 144 of the frame 145 have elongated openings 146 therein which permit the frame 145 to rock and shift relative to the shaft 64. The frame 145 carries a pair of dogs 147 and 148 which are mounted upon pins 149 extending across between the side members 144. The dogs 147 and 148 are, in turn, in line with the teeth of the gear 143 and are urged inwardly into engagement therewith by leaf springs 150. The frame 145 has outwardly extending ears 151 which are embraced by clevises 152 mounted on the upper ends of piston rods 153 of two air cylinders 154 and 155.

A support frame 156 extends upwardly between the cylinders 154 and 155 and mounts a pair of upwardly extending stop pins 157 for the dogs 147 and 148. The air cylinders 154 and 155 are controlled, respectively, by solenoid controlled air valves diagrammatically indicated at 158 and 159, respectively, in FIGURE 3. The solenoid controlled air valves 158 and 159 are actuated by signals transmitted thereto from the three micro switches 134, 135, 136 of FIGURE 16.

If, as assumed above, clockwise rotation (FIG. 3) of the shaft 64 adjusts the press for the production of thicker green goods, the micro switch 134 controls the solenoid controlled air valve 158 for admitting air to the air cylinder 154. Ejection of the piston rod 153 from the cylinder 154 rocks the frame 145 in a clockwise direction (FIG. 3) thrusting the dog 148 against its stop pin 157 to disengage the dog 148 from the gear 143 and lifting the dog 147 off of its stop pin 157 so that its spring 150 urges the dog 147 into contact with the teeth of the gear 143. A stroke of the cylinder 154 thus rocks the frame 145 in a clockwise direction and by engagement of the dog 147 with the gear 143 rotates the shaft 64 an increment in a clockwise direction. This results in the die ring 27 being lifted farther above the lower punches 45 upon the next actuation of the press and the production of a pressing of green goods 72 slightly thicker than the particular pressing of green goods just gauged in the thickness gauging mechanism 120 of FIGURES 16-18.

Conversely, if only the micro switch 136 is closed during the gauging operation, the solenoid controlled valve 159 is opened to actuate its air cylinder 155 and thrust its respective piston rod 153 upwardly. This rocks the frame 145 in a counterclockwise direction (FIG. 3) resulting in the engagement of the dog 148 with the gear 143, the rotation of the shaft 64 an increment in a counterclockwise direction and the shortening of the pusher rod 55. In the next operation of the press, therefore, the die ring 27 is not lifted as high above the lower punches 45 as it was at the time of the pressing of the green goods being gauged, and the next pressing of green goods is thinner than that which was just previously gauged.

After ejection of the next pressing of green goods from the press and initiation of the next cycle of the apparatus but before commencement of the next movement of the feeding belt 112, the air cylinder 129 of the gauging mechanism 120 is actuated to draw the movable gauge bar 125 to the left (FIGS. 16 and 17) and the air cylinder 123 is actuated to lift the stop gate 121 (FIG. 18). During the next movement of the belt 112, the gauged group of green goods 72 is moved out of the gauging mechanism 120 beneath the gate 121 and the gate 121 is again lowered to stop the next pressing of green goods moving into the gauging mechanism 120 from the converging guide 114.

Cycling of Apparatus

FIGURE 19 of the drawings is a simplified diagrammatic showing of the apparatus embodying the invention and bears legends indicating its main sections and operation. In this figure, the feeding belt 112 is diagrammatically shown as being mounted upon a pair of drive rollers 160 and 161 and as extending from beneath the edge 88 of the perforated apron 74 at the left of FIGURE 19 through the area of the shutters 89, the converging guide 114 and the gauge mechanism 120. The belt 112 also extends beyond the stop gate 121 and through a packing area generally indicated at 162.

The belt 112 is moved in each cycle a distance such that a first pressing which is ejected from the press into the area of the shutters 89 and tipped up on edge by the shutters 89 is moved from the shutter area into the converging guide 114 on a first movement. During a second cycle of the belt 112, the first pressing of green goods is moved from the converging guide 114 into the gauging mechanism 120 and a second pressing moved into the guide 114. Between the second and third cycles, the

first pressing is gauged and the press adjusted for the third pressing. During a third cycle, the first pressing is moved out of the gauge mechanism 120 and into the take-off area, the second pressing is moved into the area of the gauge mechanism 120 and the third, corrected pressing of green goods 72 is moved into the converging guide 114.

Adjacent the packing area, generally indicated at 162, there may be positioned racks 163 upon which saggars or other kiln furniture may be placed by an operator who removes gauged pressings, such as the group of green goods indicated generally by the reference number 164 in FIGURE 19, from the belt 112 and places them in the saggars. Suitable racks 165 may also be provided in this part of the apparatus for the storage of packing material, etc., used in packing the green goods in the saggars or other kiln furniture. The belt 112 is driven by a belt drive mechanism generally indicated at 166, which is also controlled by the timing mechanism of the apparatus.

The cycling of apparatus embodying the invention as illustrated in the drawings is controlled by an electrical circuit shown in simplified form in FIGURE 20. In this figure, a pair of power lines 167 and 168 are controlled by normally open contacts 169 of a control relay 170. An on-off switch 171 and the coil of the relay 170 are in a branch circuit and the control relay includes a lock-in contact to hold the normally open contacts 169 closed after the switch 171 is pressed and until it is pressed again to turn off the apparatus. A control panel 172 (FIG. 19) includes a belt motor switch 173 for closing the circuit to a belt motor 174 included in the belt drive mechanism 166, and switches 175 and 176 for the drive motor 177 for the brush 83 and for air supply apparatus 178, respectively. By closing these three switches, an operator places the apparatus in condition for cycling.

Initiation of an operating cycle may be accomplished by either of two ways. A press operated cycle switch generally indicated at 179 and, in parallel therewith, a manual cycle switch 180 are connected to the line 167 and through a timer 181 to the line 168. The cycle switch 179 is mounted upon the press (FIGS. 1 and 2) in position to be closed by engagement of the end of the horizontally swingable lever 71a with the switch actuator. When the shaker box 66 is moved all the way into the press and a previous pressing of green goods is pushed out of the press and onto the shutters 89, the striker 71 on the shaker box 66 swings the lever 71a as explained above and the switch 179 is closed. The manual cycle switch 180 is located adjacent the control panel 172 (FIG. 19) positioned generally above the guide and gauge areas of the apparatus where an operator may readily reach it. Closing either of the switches 179 or 180 allows current to flow from the line 167 through the close switch and to the motor of the timer 181 and then to the other line 168.

The timer 181 has five sets of cam actuated contacts denominated in FIGURE 20 as TC-1, TC-2, TC-3, TC-4 and TC-5. FIGURE 21 is a profile graph of the five cams rotated by the timer 181 for the purpose of closing and opening the several sets of timer contacts TC-1 to TC-5, inclusive. As soon as the motor of the timer 181 has started to turn, the "Timer Cam" closes the contacts TC-1 locking in the circuit from the line 167 through the contacts TC-1 and the motor of the timer 181 to the line 168 for one rotation of the timer 181. It will be noted in FIGURE 21 that the "Timer Cam" has a lobe extending from approximately 1° to approximately 359°. Shortly after the timer has started to operate, the "Turnover Cam" reaches its lobe at approximately 5°, and closes the contacts TC-2. Current flows from the line 167 through the contacts TC-2 to the solenoid controlled air valve for the cylinder 106 which flips the shutters 89, tipping a pressing of green goods over on their edges (FIGS. 13 and 14) and onto the belt 112. At approximately 6° the

"Gauge Cam" closes its contacts TC-3 and current flows from the line 167 through the contacts TC-3 to the solenoid controlled air valve for the cylinder 129. This retracts the movable gauge bar 125 (FIGS. 16, 17) opening the space for the reception of a group of green goods the thickness of which is about to be gauged. At this point in the cycle, the belt has not started to move and there is a pressing standing on edge in the area of the shutters 89, a second pressing part way through the converging guide mechanism 114, and a third (previously gauged) pressing in the area of the gauging mechanism 120.

At about 6° the "Stop Gate Cam" closes its normally open contacts TC-4 and current flows through the solenoid controlled air valve of the cylinder 123 (FIG. 18) to raise the stop gate 121. All three of the pressings of green goods are now ready to be moved and as the timer continues to rotate and reaches approximately 20°, the "Belt Clutch Cam" closes the timer contacts TC-5 to flow current through a magnetic clutch 182 which constitutes a part of the belt drive mechanism 166 (FIG. 19). Closure of the magnetic clutch 182 causes the belt 112 to be driven by its drive mechanism 166, moving all three of the separate pressings one increment of movement forward.

It will be noted in FIGURE 21 that the extent of the "Turnover Cam" is only approximately 10° so that the shutters 89 flip upwardly and are almost immediately returned to their horizontal position awaiting the reception of a subsequent pressing. It will also be noted that the extent of the "Stop Gate Cam" is not definitely indicated. It is essential that the gate 121 remains open long enough to allow the previously gauged group of green goods to be moved beyond the gate 121 during the early portion of the movement of the belt 112. The duration of the closure of the stop gate contacts TC-4 and thus the length of the lobe of the "Stop Gate Cam" is determined by the length of the group of green goods, the lobe ending shortly after sufficient movement of the belt 112 has taken place to remove this group of green goods from the gauge mechanism 120. The lobe of the "Gauge Cam" extends from approximately 6° to approximately 355° and thus the gauge mechanism 120 is held in open position with the movable gauge bar 125 retracted until almost the end of a cycle. The "Stop Gate Cam" causes its contacts TC-4 to open, dropping the stop gate 121 after the previously gauged group of green goods have left the gauging mechanism 120 and before the next set of green goods has been moved into the gauge mechanism 120. The lobe on the "Belt Clutch Cam" extends to approximately 350°, so the belt 112 continues to move after the new pressing of green goods has come into the gauge mechanism 120, moving it against the stop gate 121 and sliding beneath the green goods so they are all brought up snugly against each other and against the gate 121. At about 350° of a single cycle, the "Belt Clutch Cam" opens its contacts TC-5 to open the magnetic clutch 182 and stop the belt 112. Immediately thereafter the "Gauge Cam" opens its contacts TC-3 and the movable gauge bar 125 moves in against the group of green goods in the gauge mechanism 120. Immediately thereafter the "Timer Cam" opens the timer lock-in contacts TC-1, stopping the timer and ending the cycle.

As explained earlier, when the gauge bar 125 moves against the group of green goods being gauged, its three contactors 138, 139 and 140 (FIGS. 16 and 20) serially engage the respective ones of the micro switches in the order 136, 135, 134, depending upon whether the group of green goods is too thick, within tolerance or too thin. If only the micro switch 136 is closed, current flows from the line 167 through normally closed contacts of the micro switches 134 and 135 in series and then the switch 136 and to a "thick" indicator lamp 183 located on the control panel 172 and to the solenoid controlled valve 159 to actuate the increment adjusting mechanism illustrated in

FIGURE 3 and so that the die ring is not raised so far on the next pressing. If the pressing is within tolerance, the micro switch 135 is also closed. This opens the circuit to the micro switch 136 and closes a circuit through an "O.K." indicator lamp 184 on the control panel 172. If the pressing is too thin, the micro switch 134 is also closed. This interrupts the circuit leading to the micro switches 135 and 136 and closes circuits leading to a "thin" indicator lamp 185 on the control panel 172 and to the solenoid controlled air valve 158 (FIG. 3) to actuate the adjustment mechanism so that the die ring 27 is raised farther on the next press closing. The gauging and sensing of thickness, the transmission of signals to the mechanism illustrated in FIGURE 3 and the adjustment of the position of the die ring 27 for the next pressing all take place between cycles during the time when the operator has the shaker box 66 held back in the position of FIGURE 4, filling the box 66 with a new charge of powdered clay.

The three indicator lamps 183, 184 and 185 are of different colors, say red, white and green, respectively, so the operator can casually observe the frequency of lighting of the red and green lamps and take steps to stop the operation to make major adjustments if either of these colors is illuminated frequently.

We claim:

1. Apparatus for handling pressings of ceramic green goods and the like after discharge from spaced dies of a forming press, said press having means for varying the spacing between said dies, each of said pressings consisting of a plurality of individual, substantially identical green goods oriented by said press in a plurality of parallel rows with said green goods having parallel major faces and lying flat on one of their major faces, said apparatus comprising in combination, means adjacent the discharge side of said press for receiving a pressing, means adjacent said receiving means for erecting simultaneously all said rows of green goods of a single pressure on edge, means for feeding said rows of green goods on edge longitudinally away from said erecting means and laterally toward each other into close juxtaposition, means adjacent said last mentioned means for gauging the total lateral thickness of said plurality of rows of green goods on edge, means responsive to said gauging for actuating said means for varying the spacing between said dies on said press for adjusting the thickness of subsequent pressings of green goods, and means for moving said pressing of green goods away from said gauging means.

2. Apparatus according to claim 1 in which the means for assembling said rows of green goods in close juxtaposition includes converging guides for said rows of green goods.

3. Apparatus for handling pressings of ceramic green goods and the like after discharge from spaced dies of a forming press, each of said pressings consisting of a plurality of substantially identical rectilinear green goods having parallel major faces and widths and lengths greater than their thickness and being oriented by said press in a plurality of parallel rows with said green goods lying on one of their major faces, said apparatus comprising, in combination, a conveyor extending longitudinally away from the discharge end of said press, means overlying said conveyor for receiving said pressing lying flat, means for simultaneously erecting all of said green goods in each of said pressings in rows on edge of said conveyor, a gauging station adjacent said erecting means, means for intermittently moving said conveyor for moving each of said pressings away from said erecting means and to said gauging station, means at said gauging station for assembling said rows of green goods in each of said pressings in close face-to-face juxtaposition and for gauging the

total thickness of said rows of green goods in each of said pressings, means on said press for varying the spacing between said dies for changing the thickness of a pressing, and means responsive to said gauging means for actuating said thickness varying means.

4. Apparatus according to claim 3 in which the means for receiving said pressing comprises a plurality of longitudinally extending, horizontal shutters mounted for pivotal movement on axes parallel to the direction of movement of said conveyor.

5. Apparatus for handling pressings of ceramic green goods and the like after discharge from spaced dies of a forming press, each of said pressings consisting of a plurality of substantially identical, rectilinear green goods having parallel major faces and widths and lengths greater than their thicknesses, said goods being oriented by said press in a plurality of parallel rows with said green goods lying on one of their major faces, said apparatus comprising, in combination, a conveyor extending longitudinally away from the discharge end of said press, means overlying said conveyor for receiving said pressing lying flat, means for simultaneously erecting all of said green goods in rows on edge on said conveyor, a gauging station spaced along said conveyor from said erecting means, means for intermittently moving said conveyor for moving said green goods away from said erecting means and to said gauging station, means overlying said belt and located between said erecting means and said gauging station for guiding said rows of green goods into close lateral juxtaposition, transversely movable gauging means at said gauging station for gauging the total thickness of said juxtaposed rows of green goods, means on said press for varying the spacing between said dies for changing the thickness of a pressing, and means responsive to said gauging means for actuating said thickness varying means.

6. Apparatus according to claim 5 in which the means for intermittently moving said conveyor includes a cycle switch actuated upon discharge of a pressing from said press.

7. Apparatus for handling pressings of ceramic green goods and the like after discharge from spaced dies of a forming press, each of said pressings consisting of a plurality of substantially identical, rectilinear green goods having parallel major faces and widths and lengths greater than their thickness, said goods being oriented by said dies in a plurality of parallel rows with said green goods lying on one of their major faces, said apparatus comprising, in combination, a conveyor extending longitudinally away from the discharge end of said press, means overlying said conveyor for receiving said pressing lying flat, means for simultaneously erecting all of said green goods in each pressure in rows on edge on said conveyor, means for intermittently moving said conveyor for moving said green goods away from said erecting means, and stationary guide means adjacent said erecting means and overlying said belt for guiding said rows of green goods into close lateral juxtaposition during movement of said green goods with said conveyor.

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**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,036,355

May 29, 1962

Howard D. Mays et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 13, line 38, for "pressure" read -- pressing --;
line 65, for "of" read -- on --; column 14, line 52, for
"pressure" read -- pressing --.

Signed and sealed this 11th day of September 1962.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

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Commissioner of Patents