Jan. 29, 1952 J. M. HENDRICKSON 2,583,842

METHOD AND APPARATUS FOR CASTING CERAMIC ARTICLES

Filed July 9, 1947 5 Sheets-Sheet 1

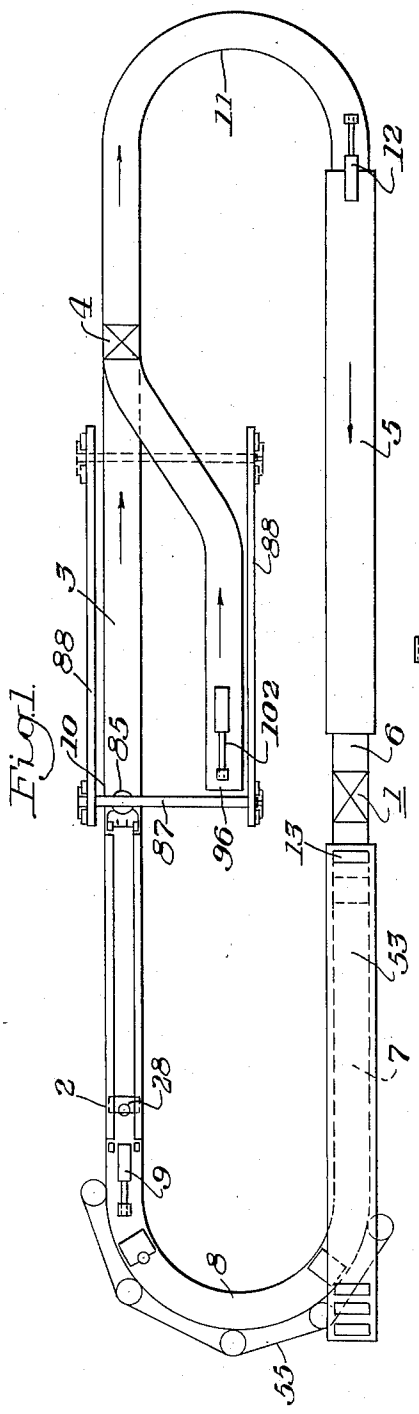


Fig. 1.

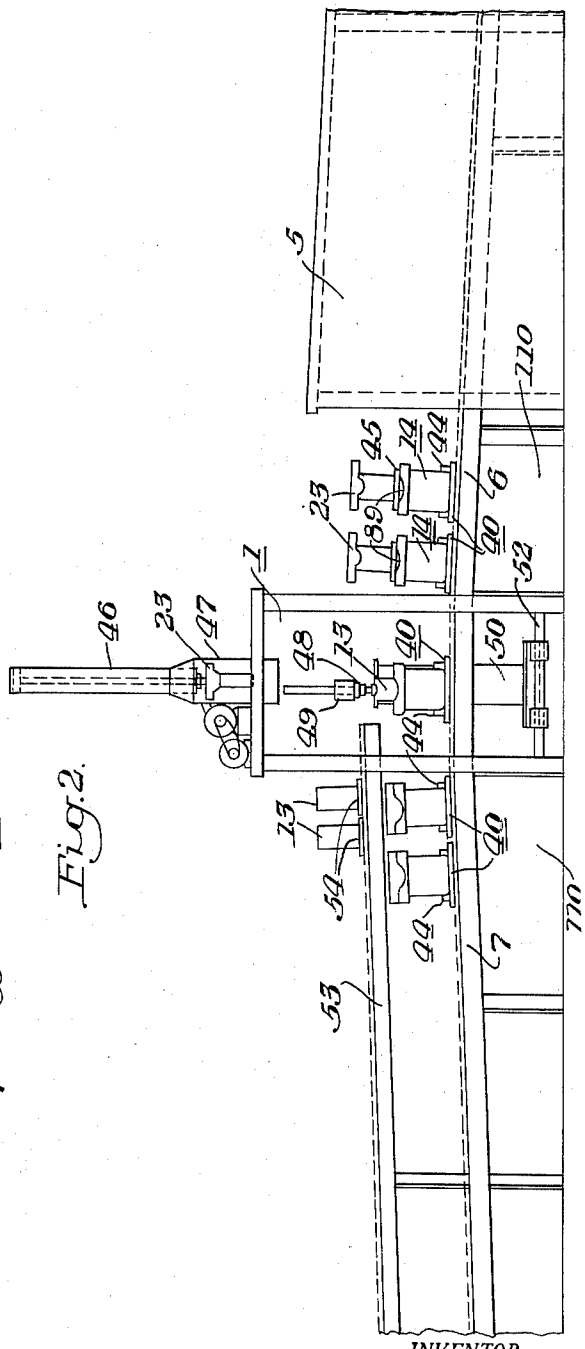


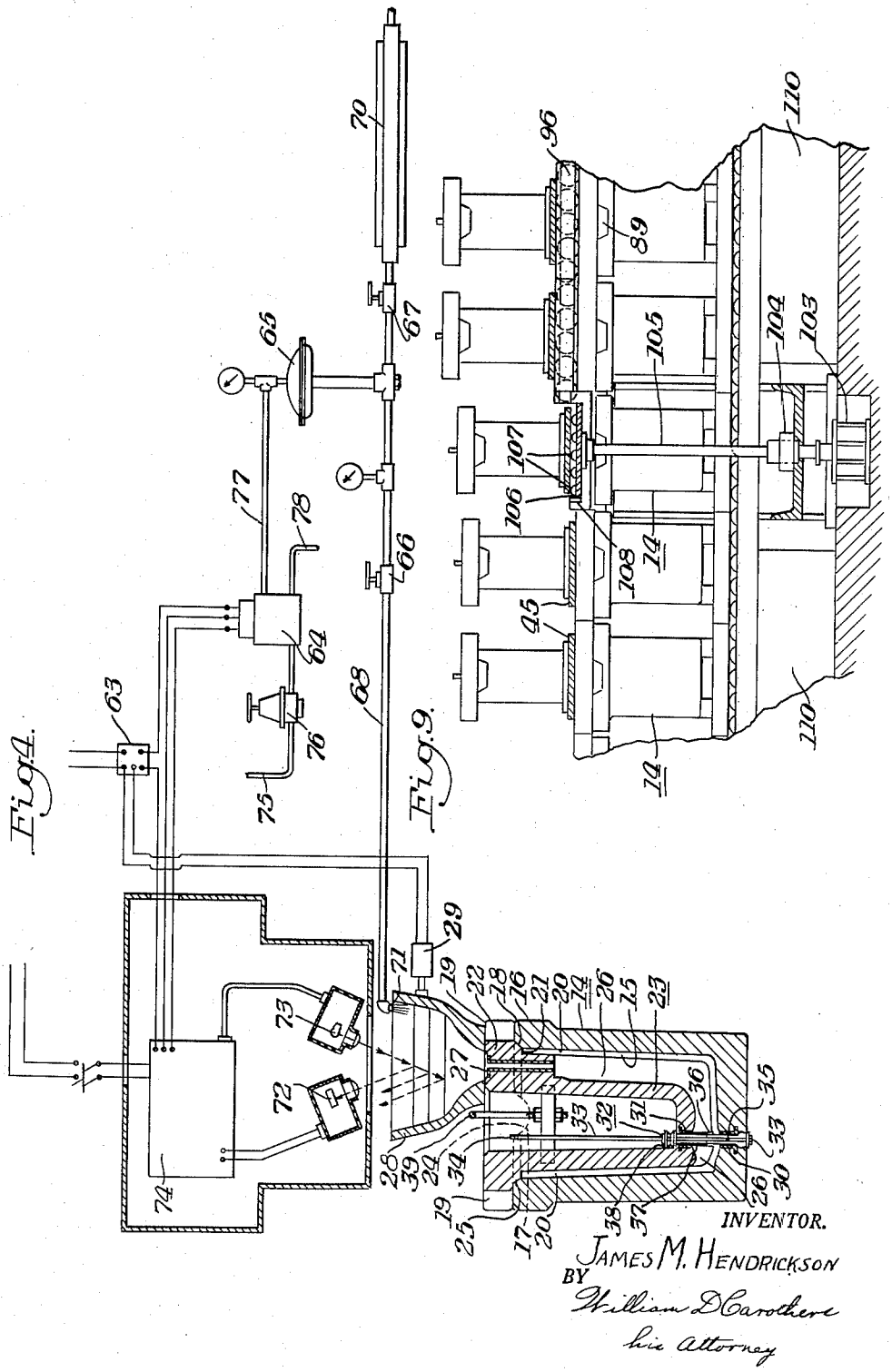
Fig. 2.

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Filed July 9, 1947 5 Sheets-Sheet 2



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METHOD AND APPARATUS FOR CASTING CERAMIC ARTICLES

Filed July 9, 1947 5 Sheets-Sheet 3

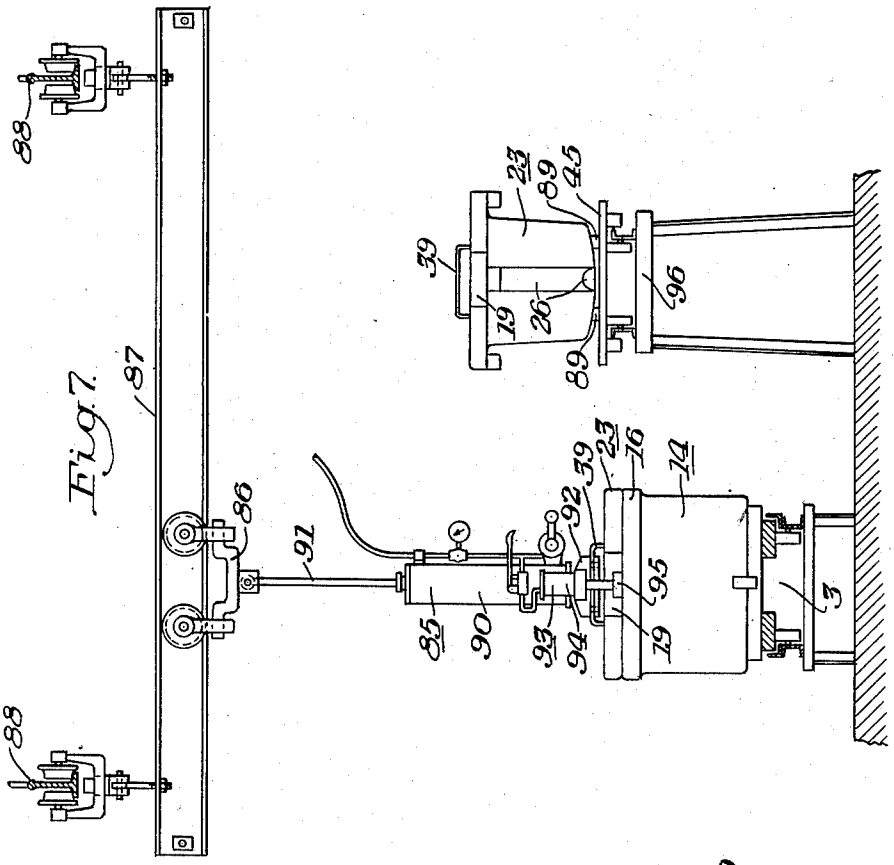


Fig. 7.

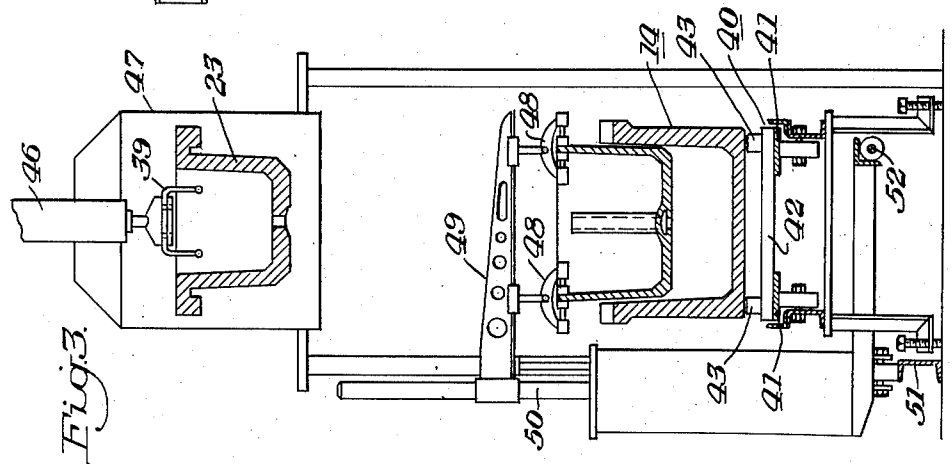


Fig. 3.

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METHOD AND APPARATUS FOR CASTING CERAMIC ARTICLES

Filed July 9, 1947 5 Sheets-Sheet 4

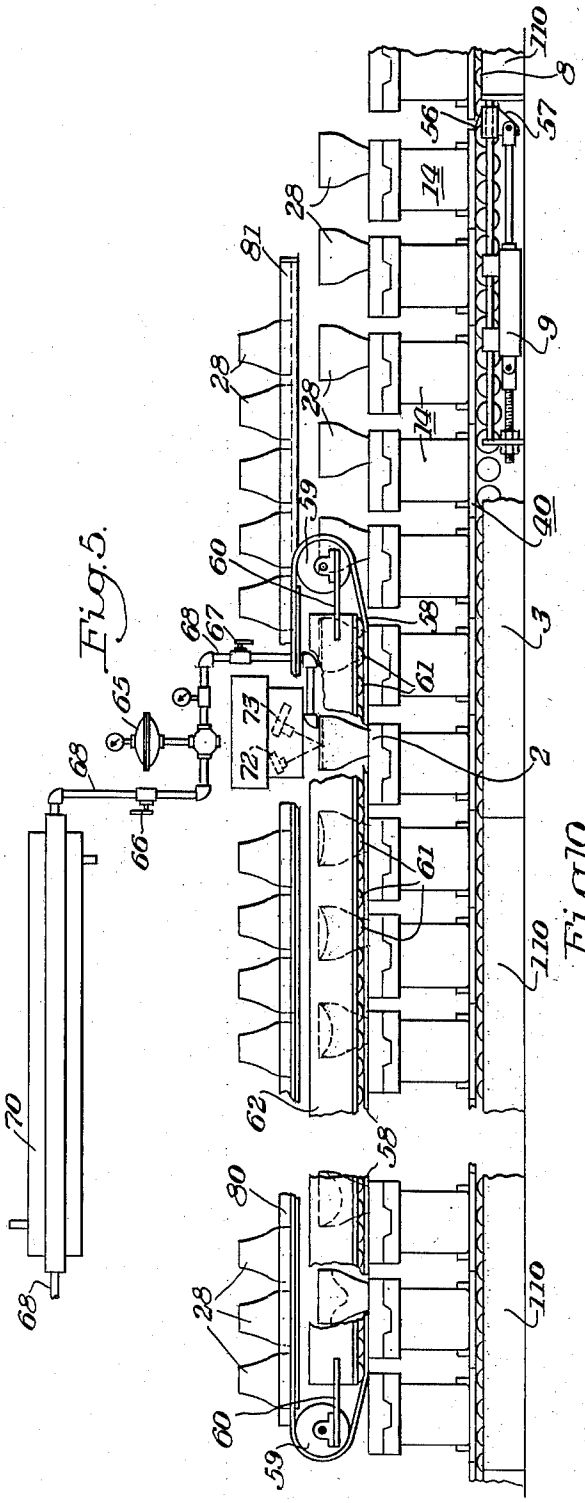


Fig. 5.

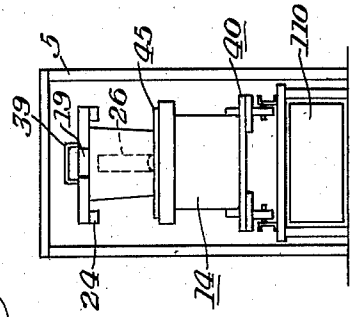


Fig. 10.

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METHOD AND APPARATUS FOR CASTING CERAMIC ARTICLES

Filed July 9, 1947 5 Sheets-Sheet 5

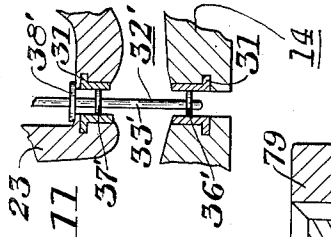


Fig. 11

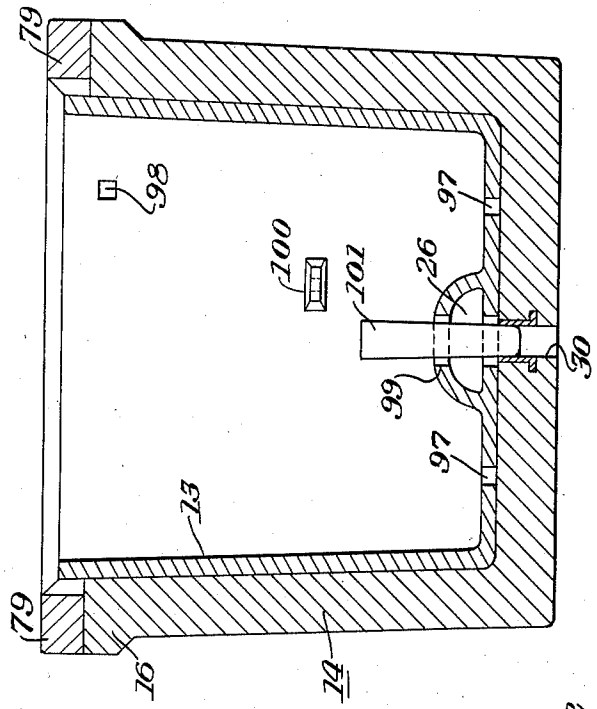


Fig. 8.

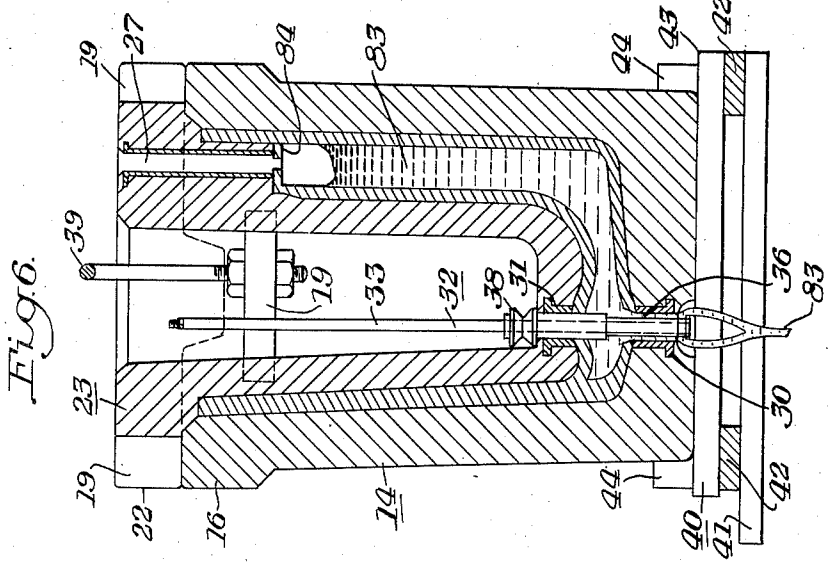


Fig. 6.

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2,583,842

UNITED STATES PATENT OFFICE

2,583,842

METHOD AND APPARATUS FOR CASTING CERAMIC ARTICLES

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Application July 9, 1947, Serial No. 759,836

10 Claims. (Cl. 25—29)

1

This invention relates generally to the art of casting ceramic articles from clay slip and more particularly to the method and apparatus for automatically casting ceramic bodies by continuously circulating porous molds in turn through successive stations for the performance of the steps of conditioning the molds, pouring the slip to fill the molds and form the casting, opening the molds to expose the cast ware, partially drying the cast ware, and extracting the cast ware from the mold.

This invention is readily adaptable for casting large ceramic bodies such as sanitary ware as well as other articles of pottery ware.

The principal object of this invention is the provision of an improved method and apparatus for casting ceramic ware.

Another object is the provision of a method and apparatus for conditioning and assembling molds preparatory to the casting of clay slip therein.

Another object is the provision of method and apparatus for applying and maintaining pressure on assembled molds to withstand the buoyancy created by liquid clay slip when the assembled molds are filled.

Another object is the provision of a method and apparatus for feeding assembled molds while maintained under pressure to withstand the buoyancy created by liquid clay slip when the assembled molds are filled.

Another object is the method and apparatus for automatically filling clay slip into assembled molds for casting ceramic articles therein.

Another object is the provision of apparatus for opening assembled molds to expose the cast ceramic ware therein.

Another object is the provision of an improved method and apparatus for conditioning cast ware immediately after it has been exposed following the casting operation.

Another object is the provision of a novel method and apparatus for initially drying cast ceramic ware prior to its removal from the molds.

Another object is the provision of apparatus for stripping the cast ware from the molds.

Another object is the provision of a novel mold in which slip castings are formed.

Another object is the provision of a method and apparatus for sealing a mold during the process of casting and drying the ware therein.

Other objects and advantages appear in the following description and claims:

A practical embodiment illustrating the principles of this invention is shown in the accompanying drawings wherein,

2

Fig. 1 is a schematic plan view of the casting machine comprising this invention.

Fig. 2 is a view in elevation of the ware take-out and mold assembly station.

Fig. 3 is a sectional view illustrating the stripping of a cast water closet tank and the dusting of the core at the ware take-out and mold assembly station.

Fig. 4 is a sectional view of an assembled water closet flush tank mold and core with a funnel and stopper at the mold feeding position together with the slip supply control circuit.

Fig. 5 is a view in elevation illustrating the mold applicator through the slip feeding and casting positions.

Fig. 6 is a sectional view of the mold showing the tank casting therein and the partial withdrawal of the excess slip.

Fig. 7 is a transverse view illustrating the core stripper and rack.

Fig. 8 is a sectional view of the mold containing the tank casting stripped of the mold core.

Fig. 9 is a view in side elevation showing the transfer of mold cores to the top of their respective molds.

Fig. 10 is a view in section showing the mold with its core traveling through the drying tunnel.

Fig. 11 is a partial sectional view showing a mechanical plug rail for closing the bottom of the core and mold.

Referring principally to Fig. 1 of the drawings the casting machine consists principally of an endless conveyor made up of a suitable frame arranged to carry anti-friction wheels or rollers over which independent mold supporting trays are moved.

When casting ware such as water closet tanks this conveyor is preferably about one hundred and thirty feet long and about twenty feet wide being substantially rectangular with semi-circular ends. The shape of the conveyor lends itself very nicely for production casting requiring a minimum of two operators who have ample room between the conveyor flights in which to carry on their work.

A series of positions or stations are conveniently placed around the endless conveyor such as the ware stripping or extracting station and mold assembly position indicated at 1 near the center of the front flight of the conveyor where one operator standing within the conveyor performs both duties with the aid of mechanical equipment. Station 2 is near the beginning of the mold pressure zone on the rear flight of the conveyor and represents the mold charging or slip filling station. Station 3 immediately fol-

lows the mold pressure zone end which may extend up to the core transfer station 4. The last or 5th station or zone position is the heating tunnel on the front flight of the conveyor.

As illustrated in Fig. 2 the front conveyor flight 6 gradually rises up an inclined plane to station 1 where the molds are presented at suitable bench height for manual operation thereon. The front conveyor flight slopes away from station 1 as indicated at 7. The conveyor continues down this slope downwardly and around the circular curve section 8 to the pusher 9 from whence the rear conveyor flight 10 is substantially horizontal until it reaches the circular curved section 11 when the conveyor again slopes downwardly as it curves to the pusher 12 which represents the lowest position in the conveyor system and from which it rises gradually along the front flight section 6 to station 1, passing through the heating tunnel of station or zone 5.

The ware chosen to illustrate this invention is that of a water closet flush tank such as shown at 13 in Fig. 2. It has been found practical to produce ware of this character on the mold casting apparatus comprising this disclosure. The molds 14 are shown in most of the views either in section, as in Figs. 3, 4, 6, and 8 or in elevation as in Figs. 2, 5, 7, 9, and 10. As shown in Figs. 3 and 4 the mold 14 is a heavy plaster of Paris mold having bottom and side walls formed integrally with each other and a central cavity 15 which is the shape of the outer surface of the ware to be formed. This mold cavity surface is smooth, providing the usual porous plaster molding surface. The rim 16 at the top of the mold is made thicker or heavier than the rest of the walls. This rim 16 is provided with the recesses 17 in the center of each end wall and a sloping seal surface 18 extends around the inner edge of the rim from one recess to the other. The lower edge of this sealing surface extends to the top of the mold cavity 20 which is closed by the annular surface 21 on the underside of the flange 22 of the core 23. The core 23 is also made of plaster of Paris. It is hollow and provided with bottom and side walls extending downwardly from the annular surface 21 forming the top of the mold cavity. The core flange 22 extends outwardly and is flush with the perimeter of the mold rim 16 on which it rests in mating engagement except the middle of the sides of the flange are cut out at 19 to expose a portion of the top of the rim 16. The underside of the core flange 22 is provided with lugs 24 which mate in surface engagement with the recesses 17 and are spaced from the wall of the core by the top mold cavity surface 21. Sloping or angular sealing surfaces 25 are also provided on the underside of the core flange for the purpose of mating with the two angular sealing surfaces 18 on the mold rim.

Each core 23 is fitted to a mold 14 to provide continuous surface engagement of the mating horizontal and angular sealing surfaces including the lugs 24 mating the recesses 17. These annular mating surfaces are so formed that the core automatically centers itself into sealing relation when placed in substantial alignment on its mold. The seal therebetween the mating surfaces is sufficient to prevent the formation of a damaging flashing on the cast ware.

The cavity 20 formed between the exterior walls of the core and the interior walls of the mold are shaped to form the walls and bottom of the ware. As shown in Fig. 4 the core is provided with the groove 26 which extends down

the back wall, and across under the bottom of the core to form the integral overflow and outlet for the water closet tank. At the top of the groove 26 the core 23 is provided with the vertical brass tube 27 disposed axially of the integral overflow and through which the slip passes to fill the mold cavity. A funnel 28 is removably positioned on top of the core with its opening registering with the top of the brass tube 27.

The bottom of the mold 14 and the core 23 are provided with aligned holes 30 and 31 respectively having brass liners arranged to receive the expandible pneumatic plug 32 which is built on the brass tube 33 having an air valve 34 at its upper end. A lateral port 35 is provided in the tube 33 in spaced relation from the lower end thereof. A rubber hose 36 covers the lower portion of the tube and is clamped thereto at both ends. A reinforcing rubber sleeve 37 is slid over the upper portion of the hose 36 and preferably vulcanized in place to stiffen and enlarge the diameter of that portion of the plug. A rubber stop washer 38 is secured to the tube 33 above the upper end of the hose 36 to arrest further insertion of the plug 32. This plug is moistened and inserted into the aligned holes 30 and 31 and charged with air under pressure which flows out of the lateral port 35 and expands the hose 36 to fully stop the hole 30. The upper section with the reinforcing sleeve 37 also expands to seal the hole 31 and being larger in diameter it substantially fills the hole 31 requiring very little expansion. The tube 33 bulges as indicated in Fig. 4.

When the mold is filled with clay slip which solidifies on the mold surfaces to form the walls of the ware the excess liquid slip forming the center of the integral overflow and outlet may be drained from the mold by releasing the air from the plug 32 causing the lower portion of the hose 36 to collapse and permit the liquid slip to drain past the plug through the lower opening 30 into a trough where it is collected for subsequent reprocessing. The sleeve 37 fits the hole 31 sufficiently when deflated to prevent the liquid slip from passing upwardly through the hole 31 into the hollow portion of the core. When the slip has completely drained out of the mold the plug may be removed. A bail 39 is secured to the resilient rubber member 191 embedded or otherwise secured to the core wall as shown in detail in Fig. 6 for the purpose of raising and lowering the core and to permit the bail to be moved aside when inserting or replacing the valve 32.

Referring again to Figs. 2 and 3 the molds 14 are seated on the wood trays 40 having the longitudinally disposed spaced runners 41 which ride on the rollers of the conveyor and are connected by the spaced transverse rails 42 to which the spaced blocks 43 are secured on which the molds 14 rest. Locking blocks 44 are secured to the mold trays on each side of the molds to hold them firmly on the trays. The runners 41 extend beyond the other parts of the trays and function as spacers for maintaining the molds in proper spaced relation as they travel around the circuit of the conveyor.

When the molds leave the tunnel 5 the core of each mold is seated on the core tray 45 that is resting on top of a mold.

As these molds approach station 1 the operator lowers the hoist 46 which hooks onto the bail 39 of the core and elevates it to within the dust hood 47 where four nozzles automatically spray a dust on the whole of the core surface for a short

period of time and stop. The operator removes the core tray 45 from the mold and lowers the air grippers 48, which are movably mounted on the arm 49 secured to the pneumatically operated hoist stem 50.

The grippers 48 comprise two sets of four biased pneumatic plungers with two opposing pairs of plungers in each set having rubber pads on the ends thereof. The grippers are adjusted on the arm 49 so that when retracted each set is directly above the end walls of the ware in the mold and in alignment with the mold recesses 17. The hoist stem 50 is then lowered to place the opposing pairs of plungers in the mold recesses 17 with their gripping pads on opposite sides of the ware end walls. Air is then applied to these plungers. These eight rubber-fingered plungers grasp the leathery ware with a force sufficient to lift the ware out of the mold but insufficient to injure destructively or mark the walls. The grippers swivel relative to the arm 49 and thus provide a direct vertical pull on the leathery dry ware. The ware is grasped by the grippers as shown in Fig. 3 and raised as shown in Fig. 2. The stem hoist 50 is movably mounted on the rails 51 and 52 and when the ware is clear of the mold and the ware conveyor 53 it moves to the left in Fig. 1 and automatically deposits the ware on the pallet 54 resting on a trip switch which functions to release the pneumatic plungers when the cast ware strikes the pallet. The ware then travels by gravity to the end of the conveyor 53 where a finisher picks it off to scrape and sponge it in finishing the surfaces preparatory to drying and glazing before firing.

When the ware has been stripped or taken out of the mold 14 the operator at station 1 cleans and checks the mold and dusts or sponges the cavity whichever is necessary. The elevator 46 is then lowered to place the core in its mold. The plug 32 is set in the core and mold and inflated. The mold parts are then completely assembled and the mold is shoved out of station 1 and down the gravity conveyor 7 on its way to the filling station and the operator then repeats the same operations on the next adjacent mold from the front flight conveyor section 6.

As the molds pass down the conveyor flight section 7 to curve 8 a flexible intermittently motor driven belt 55 engages the tray 40 of each mold and aids its movement around the curve 8. The operation of the belt is such that it will accumulate the molds on their trays toward the end of the conveyor curve 8 so that the trays are engaging one another and will be presented in turn to the pusher 9 for feeding each mold in turn along the rear flight 3 of the conveyor.

When the assembled molds are grouped together on the conveyor curve 8 the funnels 28 are placed over the feed tubes 27 of the cores. These funnels have been cleaned and are sufficiently heavy to maintain their positions on the molds in spite of the vibration due to the movement of the molds along the conveyor.

As the pusher 9 moves on its return stroke it trips a switch that energizes the motor driving the belt 55 which feeds the foremost mold onto the rear conveyor flight section 3. This mold then trips a second switch when in position to be engaged by the pusher, to stop the belt 55.

As each mold is fed from the conveyor curve 8 by the belt 55 the dog 56 on the slide 57 of the pusher 9 engages the rear of the transverse rail 42 of the tray 40 and moves the mold tray thus engaged, together with all of the other mold trays

ahead of it, along the rear flight of the conveyor in intermittent steps with two steps for each stroke of the pusher movement. The operation of the pusher and time periods during which it functions are controlled by a timer with two time delay relays controlling the starting and stopping of the timer, which may be set to produce a predetermined cycle of operation of the pusher and consequently the machine. The timer provides a pusher cycle of two and one half minutes but may be varied. The periods of operation and dwell of this cycle must also be set to coordinate with a predetermined casting and drying period and the manual operations must be so governed as to properly coordinate with these other functions of the machine.

When the mold is in position to be shoved forward by the pusher 9 the starting relay energizes the timer which in turn energizes the pusher to move a preceding mold into feeding position. The timer then stops the pusher 9. The mold at the feeding position engages a switch that opens the valve permitting the slip to pour into the funnel on the mold core.

At the end of the initial movement of the pusher one mold in the line is presented to the feeding station 2 where it dwells a sufficient length of time to be filled with slip. At the end of the last movement of the pusher it shoves the recently filled mold together with all of the molds in the line to an intermediate position relative to the feeding station for the purpose of moving the mold adjacent the transfer station 4 into transfer position for the purpose of receiving its corresponding core number. During the next dwell period the pusher returns to engage the dog 56 on the tray of the next succeeding mold from the conveyor 8 and the mold feeding cycle is again repeated to present the next mold in line to the feeding station and the next mold in line to the transfer station depending upon the relative position of the molds along the line on the rear flight conveyor section 3.

Owing to the fact that the core 23 is set into the mold 14 it is necessary that some means be provided to clamp the core to the mold during the period that the slip in the mold cavity has not solidified. The buoyant effect of the liquid slip would raise and float the core in the mold. This clamping pressure is accomplished automatically by the parallel pressure belt tracks 58 which form a pressure throat with the conveyor.

These pressure belt tracks 58 comprise a pair of parallel endless belts carried by the idling and pulleys 59 rotatably supported on the frame 60 which also carries a long series of spring loaded rollers 61 within the housings 62. The spring loaded rollers bear against the inside surface of the lower flight of the pressure belts 58 forcing them into pressure engagement with the top of the core on each ide of the bail 34 and pressing it tightly on the mold. These pressure belts engage the core of the mold that is located at least one position ahead of the feeding position and continue this pressure on twenty or so molds from the feeding station to the end of the belt flight. With a mold feeding cycle of two and one half minutes by the pusher the molds remain under pressure for approximately 50 minutes but funnels remain on at least four molds that have been moved beyond the mold pressure thus extending the casting period to approximately one hour before being opened.

When a mold arrives at the feeding station 2

either the tray 40 or the funnel 28, the latter being employed in Fig. 4, actuates the microswitch 29 which energizes the relay 63 that in turn functions to operate the solenoid 64 to supply air for the purpose of opening the pneumatic slip pressure-regulating and shut-off valve 65 which is positioned between the two manual valves 66 and 67 in the slip feed line 68 which directs slip to the funnel 28 to fill the cavity of the assembled mold.

The slip is prepared and placed in a supply line 68 under pressure and is carried by the line 68 through the thermally controlled steam heater 70. The slip then passes on through the valves 67 and 66 to the nozzle 71 where it discharges into the funnel 28 on the mold at the feeding station.

A light sensitive device such as the photo-electric cell 72 is disposed at an angular position above the mold at the feeding station and a source of light 73 is positioned at an opposed angle. The angle of incidence of the beam of light from the light source 73 is equal to the angle of reflection and comes in line with the photo-electric cell when the liquid level of the slip rises to a predetermined point within the funnel 28 as illustrated in Fig. 4. The funnel is sufficiently large for the purpose of holding enough liquid slip to maintain the mold cavity filled during the process of casting the ware. It will be noted from Fig. 5 that the slip level in the funnels decreases as the molds progress during the casting period.

When the level of the slip within the funnel 28 at the feeding station rises so that the light beam is directed into the photo-electric cell 72, the latter energizes the amplifier 74 to actuate the pneumatic solenoid valve 64 to exhaust air under pressure from the regulator shut-off valve 65 and stop the flow of clay slip from the nozzle. The regulator valve 65 retains the slip shut-off until it is again energized by the next succeeding mold tripping the switch at the feeding station to re-energize relay 63 and actuate the pneumatic solenoid valve 64 to apply air under pressure for opening the valve and permitting the slip to flow into the funnel of the next mold. Thus the automatic control of opening the valve to feed the slip depends upon the presentation of a mold at the feeding station and the automatic shutting off of the clay slip depends upon the height of the clay slip in the funnel. Thus different mold sizes may be placed in the same line and properly filled for casting. This is an important object of this invention.

Air for the operation of the regulator valve 65 is supplied through the pipe 75 and flows through the pneumatic regulator 76 to the solenoid valve 64 which charges or exhausts the air from the regulator valve 65 through the pipe 77, the exhaust line being indicated at 78.

A trough 80 is placed under the return flights of the pressure belts 58 for the purpose of providing a conveyor to return the funnels to the inlet end of the pressure track where they are shoved onto the storage trough 81 beyond the feed end of the pressure track, as shown in Fig. 5.

As previously stated the liquid slip in the funnels diminishes in level during the casting period as indicated in Fig. 5 and the funnels are permitted to remain on at least four molds after they have passed from under the belt pressure track to insure a complete casting period. The funnels and excess slip are then removed from the top of the core, the excess slip is poured into a trough below the mold conveyor and any clay that has molded on the walls of the funnel is removed. The funnels are cleaned and placed on the return conveyor made by the pressure belt track. Any flashing formed between the mold and the funnel is scraped off and the air is exhausted from the plug.

When the plug 32 is exhausted its lower flexible tube 36 is retracted as shown in Fig. 6 permitting the liquid slip 83, within the formed integral overflow and outlet, to flow past the plug 32 through the bushing 30 to a belt conveyor, not shown, in a trough below the mold conveyor from whence the excess slip is collected and reprocessed. The slip inlet pipe 27 is substantially clean but a bridge wall form 84 is cast across the top of the integral overflow but a hole remains in this bridge wall which admits air permitting the slip to readily drain and leave an integral overflow and outlet in the tank. When the slip is drained the plug 32 is removed and deposited in water for use by the operator at station 1.

In place of the pneumatic plug valve 32 a mechanical plug valve 32', such as shown in Fig. 11, may be employed. The plug valve 32' comprises a stem 33' with a pair of spaced recesses arranged to receive the flexible rubber valve rings 36' and 37' which seal the respective bores of the lower and upper tubes 30 and 31. A rubber stop 38' is secured to the stem 33' so that it engages the bottom of the core 23 when the valve rings seal their respective bores. When this valve is partially raised the slip flows through the lower bore 30 while the upper bore 31 remains sealed and the valve 32' may be fully withdrawn when the slip starts to flow out of the lower bore 30.

When the plug 32 is removed from the mold the core is ready to be pulled out of the cast ware. This is accomplished by means of the pneumatic hoist 85 shown in Fig. 7. The hoist is suspended from the carriage 86 movably mounted on the mono-rail 87 that is in turn arranged to travel longitudinally of the mold conveyor being suspended from the track 88. The hoist 85 is provided with a movable cylinder 90 reciprocably mounted on the suspended piston rod 91. The lower end of the cylinder is provided with a double fingered hook 92 arranged to engage the bail 39 of the core 23. An air jack 93 is provided on each side of the hook 92 which jacks consist of a small air cylinder 94 having a piston therein with a piston rod with a pad 95 attached to its lower end. When the hook 92 is disposed to catch its spaced fingers on the bail 39 of the core 23 the air jacks are aligned with the cut-outs 19 of the core flange 22 and when air is applied to the hoist cylinder 90 to engage the fingers on the bail air is simultaneously applied to the jacks to extend their piston rods and force the pads 95 against the exposed top surface of the mold rim 16 as shown in Fig. 7. This action of the jacks 93 on opposite sides of the mold lifts the core upwardly breaking the initial high friction and strips the core free of the ware cast within the mold. An increasingly amount of air is admitted to the hoist cylinder 90 causing it to rise on the rod 91 and raise the stripped core out of the ware in the mold. When raised to the top of its stroke the hoist is then manually shoved to the right causing the carriage 86 to roll along the rail 87 until the core is above the core conveyor 96 where the hoist is exhausted to lower the core

23 on the sloping rubber strips 89 mounted on the top of the core tray 45 resting on the core conveyor.

Thus the core is removed from the mold and the cast ware is exposed to the air as shown in Fig. 8. The operator who removes the funnels and plugs also strips the core and performs initial finishing steps on the cast ware. These initial finishing steps consist of inspecting the ware for faults, cutting the mounting holes 97 in the bottom of the ware 13, the square handle hole 98 in the front wall and cutting the holes formed by the plug 32 larger in diameter as shown at 99. A cast clay lug 100 having a hole therein is wetted on the bottom and pasted to the inside of the front wall and forms an integral bracket to hold the flush valve guide after the ware has been burned. The hole in the bridge 84 at the top of the integral overflow is also enlarged. Other initial finishing steps may be applied to the ware at this time such as sponging the rim of the tank and pulling the leathery wall away from the mold surface to break the contact therebetween without distorting the ware. This aids the ware in drying and prevents it from sticking to the mold walls causing a tear when the cast clay shrinks as it continues to dry. Other types of ware cast on this machine would of course have to undergo different initial finishing steps.

When the ware is finished a plug 101 is placed in the hole 30 at the bottom of the mold to prevent the circulation of air up through the mold during the drying period. It was discovered that air that is permitted to pass upwardly through the mold and ware at this time causes some parts to dry out at a faster rate than others resulting in the production of strains in the ware when leathery which strains create cracks during the subsequent forced drying and burning periods. Filler blocks 79 are placed in the recesses at the ends of the molds 14 to prevent the liftout sections of the tank from becoming too dry.

The initial finishing steps of the ware being completed, it continues on the conveyor to the core transfer station 4, indicated in Fig. 1 and shown in Fig. 9. The core conveyor 96 also has a pusher 102 energized by the same timer that controls the operation of the pusher 9, but at a different position in the cycle of the timer. The pusher 102 moves the cores on the conveyor 96 to the transfer station 4 where they ride over the molds on the rear flight 10 of the mold conveyor. The molds 14 are presented in turn to the transfer station 4 at the end of the second movement of the pusher 9 which represents the full extent of its forward or feeding stroke. The mold at the transfer station trips a switch adjacent the mold conveyor to energize the means to return the pusher 9. The timer functions to energize the actuating cylinder 103 that raises the cross yoke 104. A riser 105 is supported on each end of the cross yoke 104 and extends above the open mold 14 Each riser is provided with an inturned flange 106 provided with a series of elevator conveyor rollers 107 which when raised forms an extension of the core conveyor 96. A stop 108 is provided to arrest the movement of the core tray 45.

At a selected time during the cycle of the timer the cylinder 103 is energized to raise the elevator conveyor rollers 107 in line with the core conveyor 96. After this operation the timer energizes the single stroke core pusher 102 to move the core at

the transfer station on to the elevator conveyor rollers 107. When the core tray 45 engages the stop the cylinder 103 is discharged and the elevator descends, allowing the core tray 45 to rest upon the mold 14. Since the cores are taken from the molds in turn and placed on a core tray supported by the core conveyor in the same order and the timer functions to actuate the pushers 9 and 102 every cycle of its operation the matched core and mold come together at the transfer station and are thus always kept together when used on the machine. The inturned flanges 106 of the elevator provide clearance for the runners on the bottom of the core trays and as the elevator descends the runners engage and rest on top of the mold while the elevator conveyor rollers 107 drop below and out of engagement with the core tray 45 thus carrying the stop 108 clear of the tray.

As previously stated, a switch stripped by the mold trays at the transfer station 4 functions also to retract the pusher 9 for engaging the tray of the next succeeding mold and the first part of the next pusher stroke the mold is moved partially away from the station 4 and upon completion of its stroke the next successive mold is moved into position at the transfer station.

The pusher 9 moves the molds to the conveyor curved section 11 shown in Fig. 1 from whence they move by force of gravity to the lowermost position noted at pusher 12. Pusher 12 is also energized each cycle of the timer and makes one complete stroke, picking up one mold at a time and moving all of the molds ahead of it up the inclined mold conveyor section 6 through the tunnel 5 wherein conditioned air is applied to the molds to condition the core on top of the mold and further dry the ware preparatory to stripping it from the mold at station 1.

With the exception of the mold assembly station 1, the feed station 2, a portion of the initial finishing station 3, and at the transfer elevator, the whole of the mold conveyor is provided with a heating means thereunder as illustrated at 110 in Figs. 2, 5, 9 and 10. The preferable manner of heating is by using ducts for distributing hot air. The air is heated to a predetermined degree and provided with the proper amount of humidity. Its distribution to the several duct sections is controlled to properly treat the molds and cores when assembled or when separated.

By properly controlling the temperature and humidity of the ambient atmosphere the molds and cores may be closely controlled and thus require little correction at station 1 where they are assembled. In this manner the molds and cores will not become overly saturated and can be used continuously to produce fine ware. The mold conveyor need not be filled completely with molds and mold trays. There may be a gap between the molds at either end along the circular paths 8 and 11 and at the mold assembly station 1.

I claim:

1. The method of casting bodies which consists in, providing a mold cavity to produce cast ware, providing an opening into the cavity, pouring the casting material through the opening into the cavity to fill the same, and employing a reflection from the surface of the casting material as it rises in the opening to shut off the casting material when the mold is filled.

2. The method of casting bodies in the cavity of partible molds from clay slip which consists in, assembling the partible molds, moving the molds in turn to a feeding station, applying pressure on the molds to maintain them in assembled

relation, pouring slip into the cavity of the mold to fill the same, employing a reflection from the surface of the slip filling the mold cavity to shut off the flow of slip thereto, continuing the pressure on the filled molds until the slip casts and sets therein, and opening the mold to permit further setting of the casting.

3. The method of casting bodies from clay slip in the cavity of partible molds which consists in, assembling the partible molds and providing an opening to the cavity, moving the molds in turn to a feeding station, applying pressure on the molds to maintain them in assembled relation as they are being moved to and beyond the feeding station, pouring slip into the cavity opening of each mold at the feeding station to fill the same, shutting off the supply of slip by a reflection of the surface of the slip in the cavity opening, removing the pressure on the molds after the slip sets therein, opening the molds to augment further setting of casting, removing the casting from the open mold, drying the casting, and firing the casting to vitrify the same.

4. In a clay slip casting machine the combination of a conveyor, independent partible molds movable along the conveyor in predetermined spaced relation, means for filling the partible molds with clay slip intermediate of their travel along the conveyor, endless belt means engaging the partible molds for a limited distance of their travel along the conveyor, means to exert pressure through the endless belt means and the partible molds to the conveyor while the molds are being filled with slip and until the slip loses its buoyant effect by solidifying as the molds progress along the conveyor, and means for opening the molds after predetermined curing of the slip to permit the ware to further dry and be removed.

5. In a device for filling a cavity through an opening in a mold, the combination of a filling nozzle for directing the liquid into the opening, a source of light arranged to direct a beam of light into the opening, light sensitive means mounted to receive a reflected beam of light from the surface of the liquid as it rises to a predetermined elevation in the opening after filling the mold cavity, and means to shut off the flow of liquid from the nozzle and actuated by the light sensitive means responding to a reflected beam of light from the liquid surface in the opening.

6. In a device for filling a cavity through an opening in a mold, the combination of a filling nozzle, a valve for controlling the flow of liquid through the nozzle, means for opening the valve when the mold is presented thereto for filling its cavity through the opening, a lamp mounted to project a beam of light into the opening, light sensitive means mounted to receive the beam of light when reflected from the surface of the liquid as it rises to a predetermined elevation in the opening after filling the mold cavity, and means actuated by the light sensitive means to close the valve when the light sensitive means responds to a reflected beam of light from the liquid surface in the opening.

7. In a device for filling a cavity through an opening in a mold, the combination of a filling nozzle, a valve for controlling the flow of liquid through the nozzle, means for opening the valve when a mold is presented thereto for filling its cavity through the opening, a lamp mounted to project a beam of light into the opening, light sensitive means mounted to receive the beam of light when reflected from the surface of the liquid as it rises to a predetermined elevation in the opening after filling the mold cavity, means actuated by the light sensitive means to close the valve when the light sensitive means responds to a reflected beam of light from the liquid surface in the opening, and means to extinguish the light beam until the valve is again opened by the presentation of another mold for filling.

8. In a mold the combination of a mold having bottom and side walls integrally joined and having a rim, a hollow core member adapted for insertion in the mold and having a flange arranged to seal with the rim of the mold and provide a cavity, said flange having oppositely disposed recesses to expose oppositely disposed portions of the mold rim, an entry in the core for filling the cavity with slip, aligned openings in the core and mold at the bottom thereof for draining excess slip after the casting has been formed, a handle secured to the core, and a stripper to simultaneously engage to lift the handle and quickly strike against the exposed rim of the mold to break and withdraw the core from the cast article.

9. In a clay slip casting machine the combination of a conveyor, partible molds with a cavity opening movable along the conveyor in predetermined spaced relation, funnels placed on said molds in alignment with their cavity opening, means for filling the partible molds with clay slip through the funnels intermediate of their travel along the conveyor, endless belt means having its lower flight engaging the tops of the partible molds for a limited distance of their travel along the conveyor, means to exert pressure through the lower flight of the endless belt means to the partible molds on the conveyor while they are being filled with slip and until the slip loses its buoyant effect by solidifying as the molds progress along the conveyor, means to support the upper return flight of the endless belt means to provide a conveyor to return the funnels to the position where they are placed on the molds about to be filled, and means for opening the molds after predetermined curing of the slip to permit the ware to further dry and be removed.

10. An apparatus for slip casting articles comprising a mold body member having bottom and side walls with a continuous rim surface, a core member having a complementary rim surface and adapted for insertion into the mold body member to form a two part mold with a casting cavity between the members and accessible for filling at the top, a mold opening apparatus with a hoist to engage and raise the core member out of the mold body member, and an additional element to exert an instant opposite force on the mold body member as the hoist engages the core member to strip the latter from the casting.

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13

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