SUPPORTING CARRIAGE FOR, AND METHOD OF CASTING IN, MOLDS FOR THE PRODUCTION OF CERAMIC HOLLOW WARE

Inventor: Jerome S. Greenberg, Chicago, Ill.
Assignee: Regal China Corporation, Antioch, Ill.
Filed: Dec. 8, 1970
Appl. No.: 96,140

Int. Cl. B28h 1/26

Field of Search 264/86, 314; 25/129, 1; 249/137; 18/43; 269/22

References Cited
UNITED STATES PATENTS
3,189,971 6/1965 Derry
3,015,137 1/1962 Hoebing
1,196,824 9/1916 Toomey

FOREIGN PATENTS OR APPLICATIONS
136,701 12/1919 Great Britain

Primary Examiner—Robert F. White
Assistant Examiner—Allen M. Sokal
Attorney—Pennie, Edmonds, Morton, Taylor and Adams

ABSTRACT
A rotatable carriage for supporting split-type plaster molds used in the casting of ceramic hollow ware comprises two end frames and two normally oppositely facing supporting frames, one of the supporting frames being fixed to the end frames and the other supporting frame being pivotally mounted on the end frames to permit loading and unloading of the molds. The pivotally mounted supporting frame has an inflatable member on its inner face which, when inflated after the frame is locked in position, secures the molds in place while the carriage is rotated about its longitudinal axis to positions permitting the filling of the mold cavity, the emptying of excess casting slip from the mold cavity and the returning of the molds to a horizontal opening position. By handling the molds in this manner during filling, casting and emptying, a new casting method is obtained.

3 Claims, 14 Drawing Figures
SUPPORTING CARRIAGE FOR, AND METHOD OF CASTING IN, MOLDS FOR THE PRODUCTION OF CERAMIC HOLLOW WARE

This invention relates to the casting of ceramic hollow ware and, more particularly, to a rotatable carriage for supporting split-type plaster molds during the pouring, setting and removal of the ware from the molds and to a method of casting such hollow ware advantageously by using such apparatus.

It has been conventional practice heretofore to cast ceramic hollow ware, such as lamp bases and bottles, in a split-type plaster mold of two complementary sections by first assembling a plurality of molds in their upright position, clamping the assembled molds horizontally to hold the mold halves together by the pressure of adjacent molds, filling each mold with the ceramic slip, waiting for a predetermined time interval sufficient for the plaster mold to absorb enough water from the slip to form a desired thickness of ceramic material on the inner surface of the mold, then unclamping the molds, separating tipping each mold upside down to pour out excess slip, then placing the emptied molds on its side and carefully raising the upper half of the mold to expose the casting so that it can be removed from subsequent firing. Handling of the filled molds in this practice, particularly because of the release of pressure required for holding the mold halves together prior to emptying the molds of excess slip, has often resulted in as much as 50 percent loss due to breakage or other deformity of the casting. In addition, although the molds could be filled in a predictable-time sequence, the time interval between filling the molds with the slip and emptying the molds of excess slip became progressively longer as an operator moved down the production line and became physically more tired as he handled each successive mold. As a result, the castings toward the end of a production line would have a greater wall thickness, and therefore a smaller volume capacity, than those near the beginning of the line, and this non-uniformity contributed to the number of rejected castings where the volume of the casting, such as those used for holding liquor, must meet critical specifications.

I have now devised a rotatable supporting carriage for split-type plaster molds used in the casting of ceramic hollow ware. This carriage comprises two spaced but substantially parallel main end frames, two spaced mold-supporting frames interconnecting the spaced end frames, each of the mold-supporting frames comprising a plurality of elongate support members laterally spaced from one another, one of the mold-supporting frames being secured at its respective ends to corresponding portions or the of the spaced end frames and the other mold-supporting frame being secured at each of its respective ends to the leg portion of an L-shaped frame member. The foot portion of each L-shaped frame member is pivotally mounted on the inboard side of each of the main frames whereby the second-mentioned mold-supporting frame can be tilted or rotated from one position in a plane parallel to but spaced from the plane of the first-mentioned mold-supporting frame to another position in a plane substantially normal to its first-mentioned position. Locking means is provided for securing the movable mold-supporting frame in its position parallel to the first-mentioned mold-supporting frame, and inflatable means is provided which extends substantially the length of one of the elongate supporting members of the movable mold-supporting frames and is secured to the face thereof adjacent a mold positioned between the two mold-supporting frames. The inflatable means is provided with a releasable inflating valve, and controllable driving means is provided for rotating the supporting carriage about its longitudinal axis.

The method of casting ceramic hollow ware in a split-type plaster mold pursuant to the invention comprises placing a plurality of such molds on their sides on a horizontal supporting frame, lowering a second supporting frame into fixed position parallel to the first-mentioned frame but spaced from the upper sides of the molds, and inflating an expansible element between the upper sides of the molds and the second-mentioned frame. The resulting assembly is then rotated about an axis such as to place the molds in an upright position for filing, the molds are filled with a ceramic casting slip, and the filled molds are held in their upright position for a period of time sufficient to form inside the molds a ceramic ware wall of desired thickness. Thereafter, the aforesaid mold and frame assembly is again rotated about said axis to up-end the molds and thus pour off the excess slip from within the molds, then the mold and frame assembly is rotated to its starting position, whereupon the expansible element is deflated, and the second-mentioned frame is raised so that the molds can be opened to remove the resulting casting.

These and other novel features of the mold-supporting carriage and method of the invention will be more readily understood from the following description taken in conjunction with the accompanying drawings in which

FIG. 1 is a perspective view, partially broken away, of a mold carriage assembly embodying the invention;
FIG. 2 is another perspective view of a molding machine embodying the invention and showing the positioning of the molds on the fixed portion of my novel mold carriage;
FIG. 3 is a partial perspective view of the apparatus shown in FIG. 2 with the movable carriage frame in mold-supporting position and showing how the inflatable means is inflated;
FIG. 4 is a partial perspective view of the carriage rotated to the mold-filling position;
FIG. 5 is a side elevation of the mold carriage driving mechanism;
FIG. 6 is a partial perspective view of a molding machine showing the interconnection of multiple mold caricages in a single machine; and
FIGS. 7 through 14 are a series of schematic end-view representations of a molding machine embodying the invention at various stages in its mold-making sequence.

As shown in FIG. 1, the supporting carriage for molds pursuant to the present invention comprises two spaced and substantially parallel main end frames 10 and 11, each advantageously in the form of a substantially square plate, and two mold-supporting frames 12 and 13 interconnecting the end frames. Each of the mold-supporting frames comprises two or more elongate members, either of rectangular or circular tubular section or of channel shape, or a combination thereof,
advantageously supported by spaced cross members. In the presently preferred embodiment of the invention, each of the mold-supporting frames 12 and 13 comprises two elongate outermost metal tubes 14 of square section and a centrally positioned parallel metal channel 15. In the fixed supporting frame 12 shown in the lower position in FIG. 1, the elongate members 14 and 15 are welded to the inner lower edges of the main end frames 10 and 11 with the flat face of the central channel member facing upwardly to form with the corresponding faces of the outermost tubes, a supporting surface for the plaster molds. The movable supporting frame 13 shown in the upper and backwardly tilted position in FIG. 1 also advantageously comprises two outermost metal tubes 14 of square section and a centrally positioned metal channel 15 with its trough-like configuration preferably facing forward so that when the frame is tilted forwardly and downwardly into mold-supporting position the trough will face the upper surface of molds supported on the lower-positioned frame 12. The elongate members 14 and 15 are supported intermediate their end frames by spaced cross members 16 welded to the sides of the elongate members. The elongate tubes 14 and channel 15 of the movable supporting frame are secured by welding or the like at their ends to the leg portions 17a and 18a, respectively, of L-shaped end frames 17 and 18. The toe of the foot portions 17b and 18b of the respective end frames are pivotally mounted at 20 on the main end frames 10 and 11, respectively, so that the movable mold-supporting frame 13 can be rotated from its upright position shown in FIG. 1 into a plane parallel to that of the fixed supporting frame 12. Tension springs 21, connected between the axis of the joint of the leg and foot portions of the L-shaped tilting frame 13 and the adjacent base of the fixed frame 12, serve as a counterbalance to hold the movable frame 13 in its upright position shown in FIG. 1. The movable frame 13 can be locked in its lowered mold-supporting position by any appropriate means such, for example, as a bar crank 22 pivotally mounted on a shaft extending through the ends of the cross members 16 and having locking rods 23 and 24 mounted at the ends of the bar so that when the bar is rotated counter-clockwise from the position shown in FIG. 1 the rods will be moved longitudinally outwardly beyond the ends of the L-shaped frame through openings 25 and into engagement with a hole 26 in a lock bracket 27 mounted on the inside surface of each main end frame 10 and 11. The bar crank shaft can be rotated by a handle 28 mounted on the opposite end of the shaft projecting beyond the upper surface of the cross member 16 through which it extends.

The positioning of the pivot 20 of the L-shaped end frame on the main frames 10 and 11 and the length of the foot portions 17b and 18b of the L-shaped frame 17 are such that when the movable mold supporting frame 13 is tilted forward and is locked in its position parallel to the fixed mold supporting frame (FIG. 3), the elongate and cross members of the movable frame 13 do not engage the upper surface of a plaster mold resting on the fixed supporting frame 12. Such contact is made solely by an inflatable means 30 advantageously extending the full length of, and at least partially contained in, the trough of the centrally positioned channel member 15 of the movable supporting frame 13. The inflatable means 30 can be constructed of any suitable material such as natural or synthetic rubber or rubberized fabric, but I presently prefer to use two overlying sheets of fabric-reinforced synthetic rubber vulcanized together along their longitudinal edges and end edges. The resulting expandable tubular structure is provided with a conventional inflation valve 31 vulcanized in its upper layer and accessible through the flat face of the channel member 15 of the movable frame. The tubular inflatable device is held in position in the channel by any suitable means such as ties 32, advantageously made of expandable strips of rubber, located at spaced intervals and encircling both the channel member 15 and the inflatable tube 30. Thus, after conventional plaster molds 33 have been placed in position on their sides on the fixed supporting frame 12, the movable supporting frame 13 has been tilted forward and locked in position parallel to the fixed supporting frame, and the inflatable tube 30 has been inflated with compressed gas such as air, the inflated tube presses against the upper surfaces of the molds 33 resting on the fixed supporting frame 12 and holds the molds securely against the spaced flat surfaces of the elongate members 14 and 15 of the fixed supporting frame 12.

As shown in FIGS. 1 and 2, the entire mold supporting assembly is mounted for rotation about its longitudinal axis by stub shafts 34 each mounted in a supporting bracket 35 secured to the outer face of the main end frames 10 and 11. The stub shafts are supported in journals 36 suitably positioned on base frames 37. As shown in FIG. 5, one of the stub shafts 34 on a main frame has secured to it a large diameter sprocket wheel 38 which is driven by a motor 40 through a sprocket wheel 41, a sprocket chain 42 and an idler sprocket 43. By offsetting the sprocket chain 42 with the idler sprocket 43, room is made under the frame assembly for a collecting trough 44 to collect excess casting slip when the molds 33 are up-ended at the termination of the casting period. Manual control of the motor 40 is provided by a conventional motor control 45 such as that shown in FIG. 4.

The sequence of producing molded ceramic hollow ware with the apparatus of the invention is shown in FIG. 7. As shown in FIG. 7 of this sequential drawing, the movable frame 13 has been tilted upwardly to a slightly backward stable position maintained by the tension spring 21. Then, as in FIG. 8, the assembled mold halves 33a and 33b are placed on their sides on the fixed carriage frame 12 with the mold fill opening facing away from the upstanding movable frame 13. The frame 13 is then rotated downwardly FIG. 9 and locked in position with its locking rods engaging the lock bracket 27, whereupon, as shown in FIG. 10 an air hose 46 is fitted to the inflation valve 31 so as to expand the inflatable means 30 sufficiently to press against the molds 33 and firmly hold them in place. The motor control 45 is then used to rotate the mold assembly 90° to the mold-upright position as shown in part FIG. 11. After all molds in the assembly have been filled through the mold opening 33c with a conventional ceramic slip supplied through a hose 47, a timer 48 (FIG. 2) is actuated. The timer runs for any predetermined period required for a desired thickness of the ceramic com-
ponent of the slip to be built up on the inner surface of the mold. When this time has expired, the timer actuates the drive motor and causes the mold and support assembly to rotate 180° as shown in part FIG. 12 so as to cause excess ceramic slip to be emptied from the interior of the molds into the collecting trough 44 from which the unused slip can be recovered. The end of this automatic cycle can be signaled by a light 50, or the like, whereupon an operator can again manually control the motor 40 to rotate the molds and support assembly back 270° to the original mold assembly as shown in part FIG. 13. Gas pressure in the inflatable tube 30 is then released through the inflation valve 31 and the movable mold support frame 13 in unlocked, raised and tilted backward to its starting position as shown in part FIG. 14. It will be readily appreciated that the off-center pivoting of the movable frame, provided by the L-shape end frame, causes the frame to move rearwardly as it is raised. Thus, after the movable frame 13 has been raised to its rearmost position, the upper half 33a of each plaster mold can be raised, after the "spare" has been removed from the pouring neck pursuant to conventional practice, and can be tilted back more than 90° so that it will lean backwardly against the now-upright movable frame without having to be completely lifted off the support frame by the operator. The ceramic ware 51 can then be lifted out of the supporting mold half 33b.

It will be seen, accordingly, that the carriage frame of the present invention permits assembly of the two mating halves of a conventional plaster frame in the horizontal position with one half above the other and that the thus-assembled molds are firmly held in this position from a casting cycle point prior to the filling of the molds until the cycle end point when the molds are opened. As a result, there is no release of pressure holding the two halves of each mold together during the entire casting cycle and consequently no opportunity for the molded casting to be unsupported until it is ready to be removed from its mold. Inasmuch as (a) the molds in one assembly can be filled in a very short period of time, (b) the excess slip is removed from all the castings simultaneously, and (c) the mold halves are firmly secured at all stages of the casting cycle, the walls of the castings are more uniform in thickness and shape than has been possible heretofore by manual manipulation. In addition, it will be appreciated that the sides of each mold are engaged only by the spaced elongate members 14 and 15 of the fixed supporting frame 12 and by the expanded inflatable member 30 of the movable supporting frame 13, with the result that most of the exterior surface of each mold is predominately exposed to the ambient atmosphere so as to promote evacuation of water which the plaster walls of the mold absorb from the ceramic slip.

The apparatus of the invention is not limited to a single mold carriage assembly such as that shown in FIG. 1 and in fact it has been found advantageous to secure several such assemblies axially as shown in FIGS. 4 and 6 by joining their stub shafts 34 so that all carriage assemblies in a single line will be operated simultaneously by the single motor 40. In addition, two such rows of multiple assemblies can be arranged in parallel rows back-to-back (the movable frames 13a of a second row being shown in FIGS. 3 and 4) so that when the excess slip is poured from the molds it will be collected in a common trough between the rows. In the latter case, the rotation of each row of multiple assemblies will be in opposite directions with access to the molds and to the supporting frames being from opposite sides of the assemblage.

1. A rotatable carriage for split-type plaster molds used in the casting of ceramic hollow ware and comprising two spaced but substantially parallel main end frames, two spaced mold-supporting frames interconnected the spaced end frames, each of the mold-supporting frames comprising a plurality of elongate support members laterally spaced from one another, one of the mold-supporting frames being secured at its respective ends to corresponding portions of the spaced end frames and the other mold-supporting frame being secured at each of its respective ends to the leg portion of an L-shaped frame member, the foot portion of each L-shaped frame member being pivotally mounted on the inboard side of each of the main frames whereby the second-mentioned mold-supporting frame can be rotated from one position in a plane parallel to but spaced from the plane of the first-mentioned mold-supporting frame to another position in a plane substantially normal to its first-mentioned position, locking means for securing the movable mold-supporting frame in its position parallel to the first-mentioned mold-supporting frame, inflatable means extending substantially the length of one of the elongate support members of the moveable mold-support frames and secured to the face thereof adjacent the mold positioned between the two mold-supporting frames, a releasable inflating valve for said inflatable means, a controllable driving means for rotating the supporting carriage about its longitudinal axis.

2. Apparatus according to claim 1 in which the inflatable means comprises two sheets of fabric-reinforced rubber vulcanized along their longitudinal and end edges.

3. The method of casting ceramic hollow ware in a split-type plaster mold which comprises placing a plurality of such molds on their sides on a horizontal supporting frame, lowering a second supporting frame into fixed position parallel to the first-mentioned frame but spaced from the upper side of the molds, inflating an expansible element between the upper sides of the molds and the second-mentioned frame, rotating the resulting assembly about an axis such as to place the molds in an upright position for filling, filling the molds with a ceramic casting slip, holding the filled molds in their upright position for a period of time sufficient to form inside the molds a ceramic ware wall of desired thickness, further rotating the aforesaid mold and frame assembly about said axis to up-end the molds and thus pour off the excess slip from within the molds, rotating the mold and frame assembly about said axis to its starting position, deflating the expansible element, and raising the second-mentioned frame so that the molds can be opened to remove the resulting casting.

* * * * *