June 22, 1965 F. L. DERROR 3,190,494

METHOD AND APPARATUS FOR FILLING MOLDS WITH SLIP

Filed Sept. 18, 1963 4 Sheets-Sheet 1

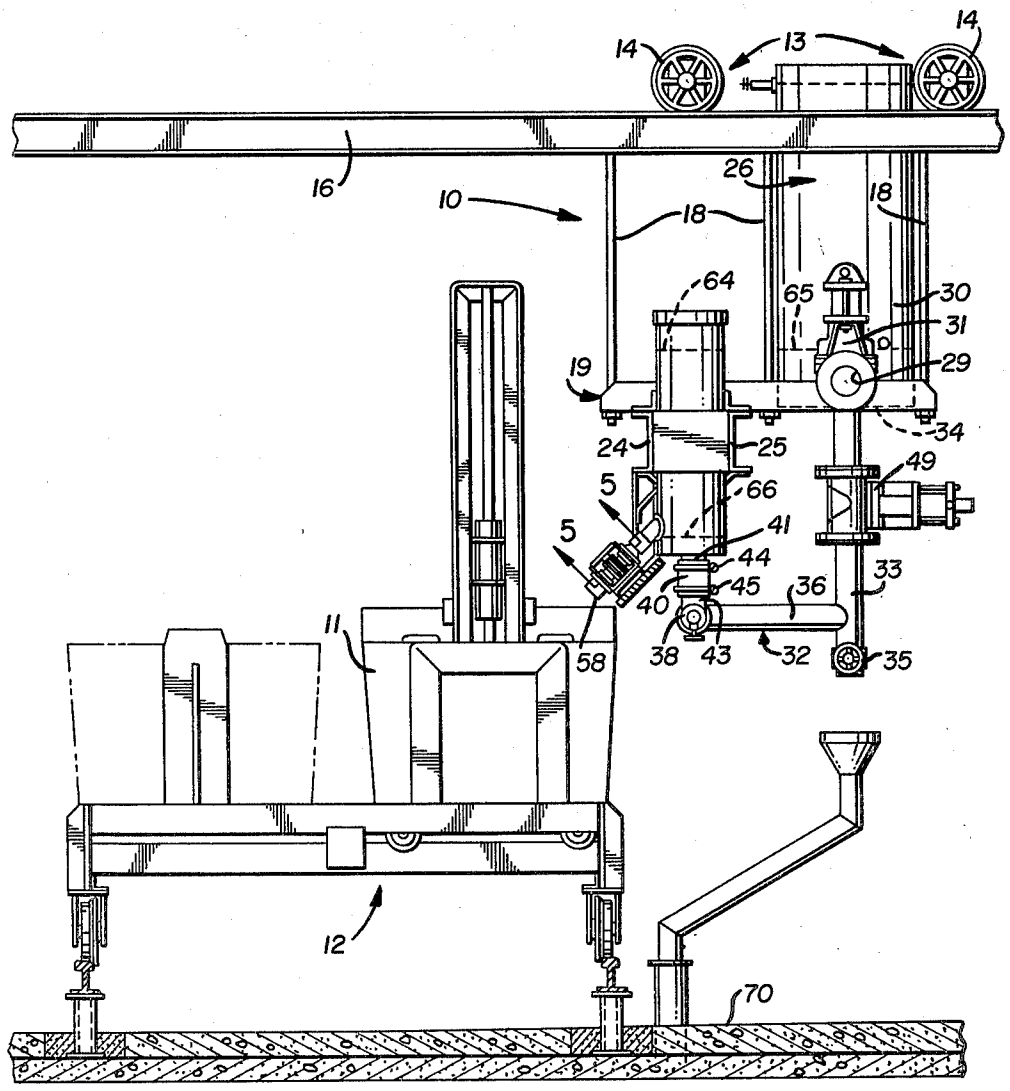


FIG. 1

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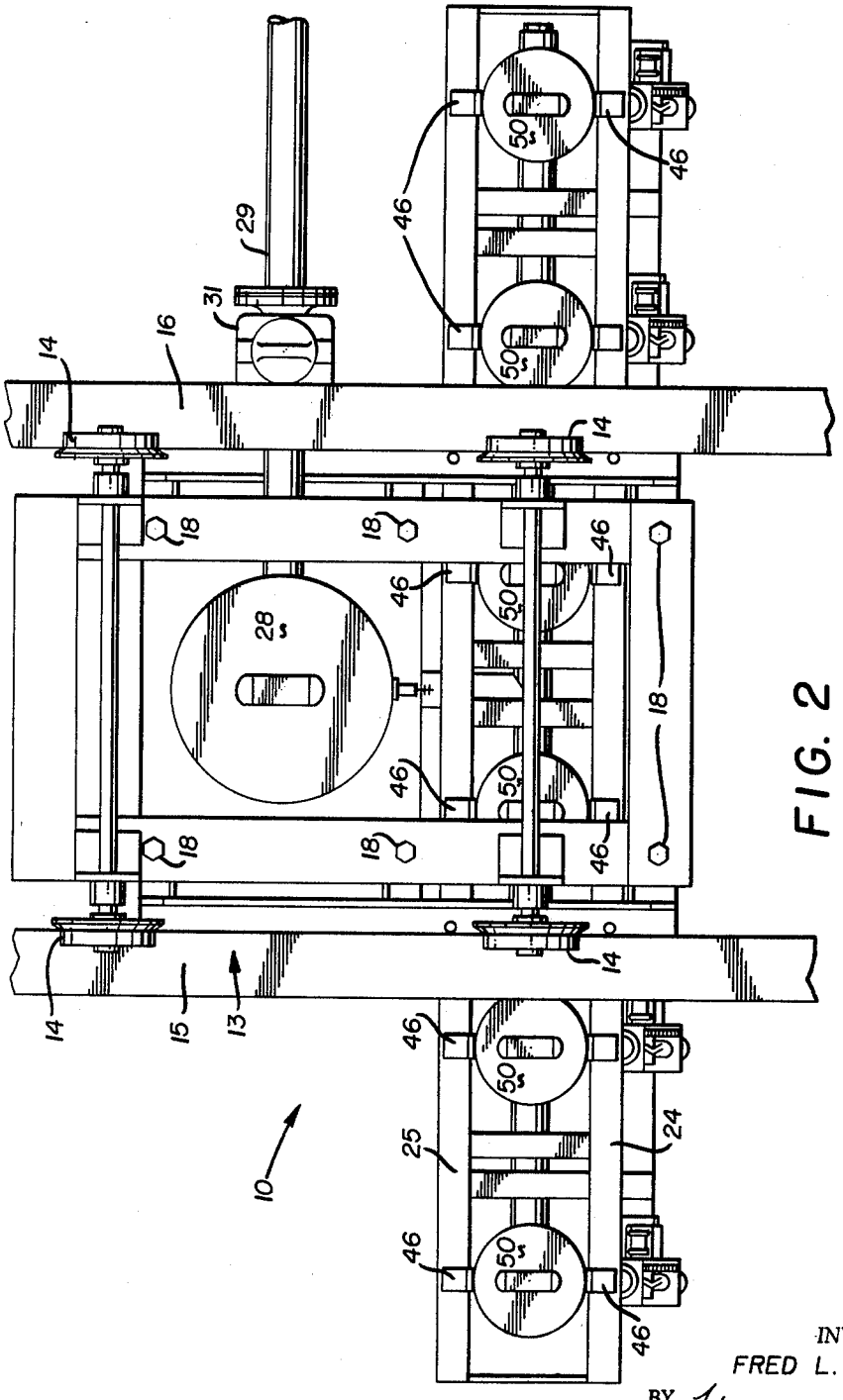


FIG. 2

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METHOD AND APPARATUS FOR FILLING MOLDS WITH SLIP

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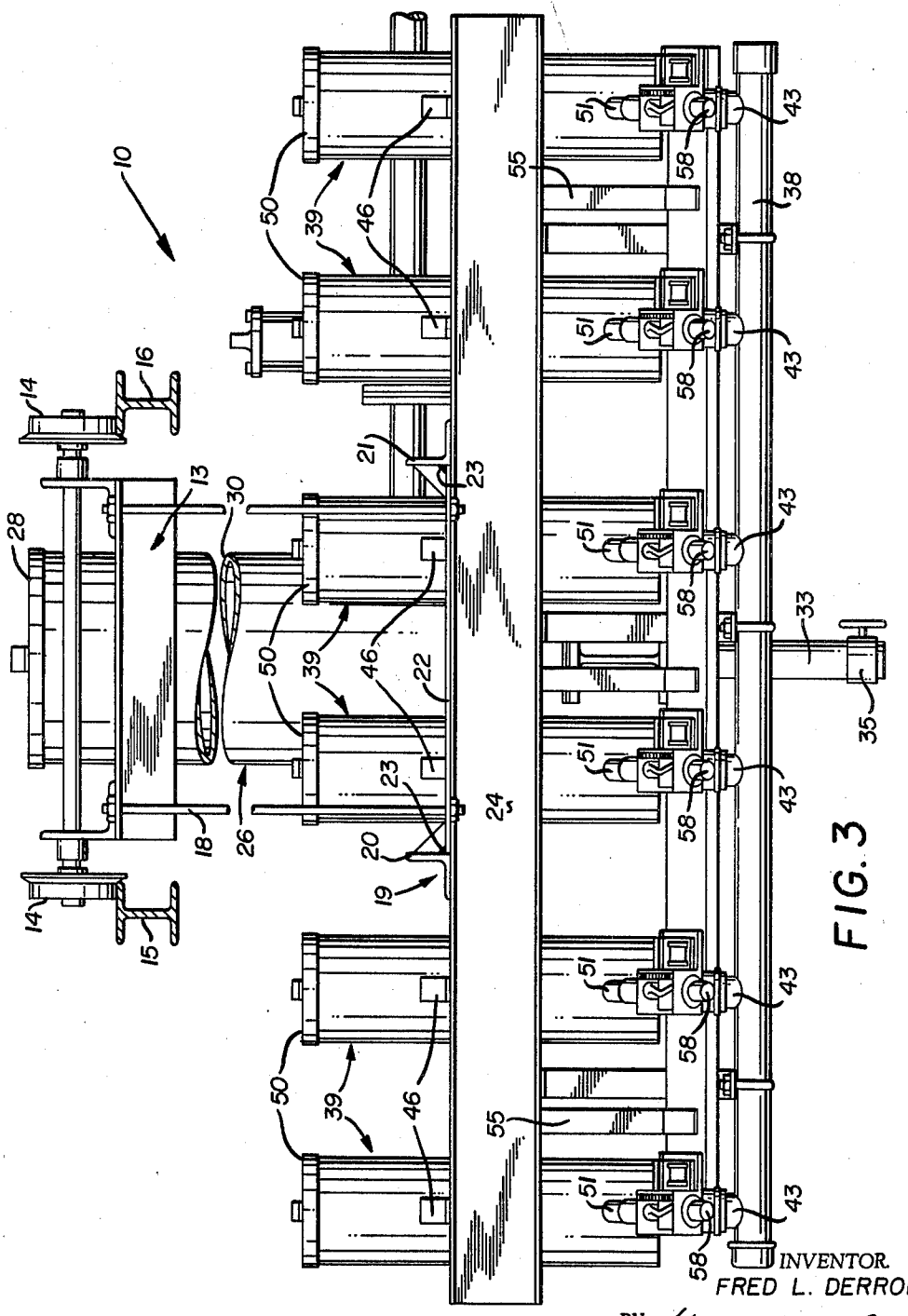


FIG. 3

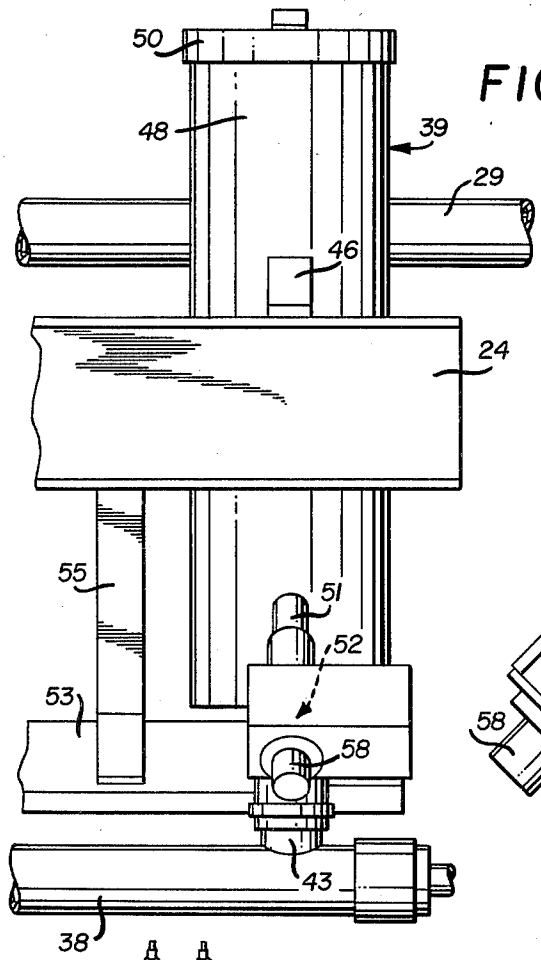
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FIG. 4



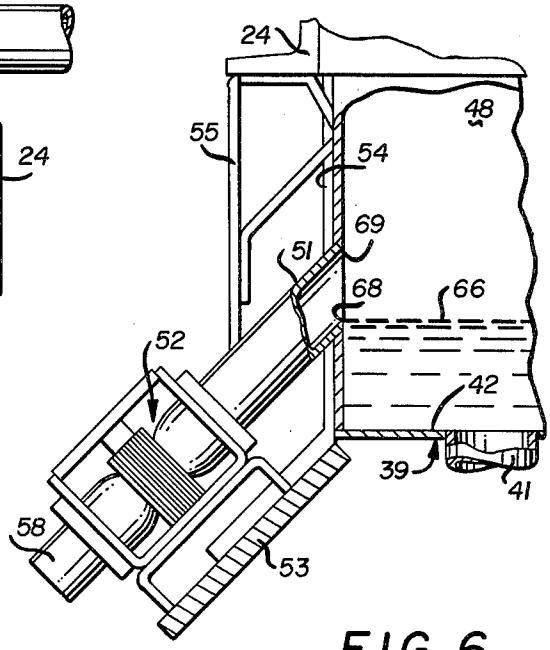


FIG. 6

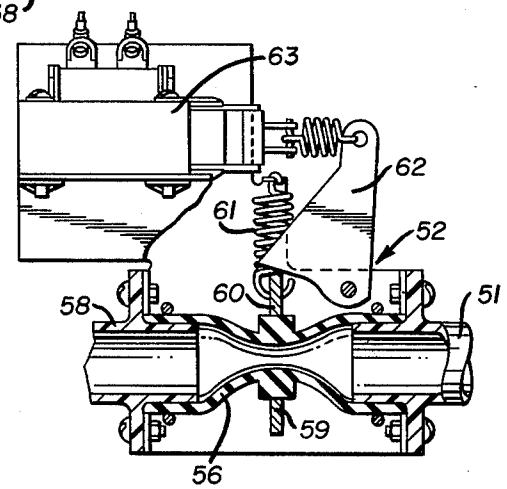


FIG. 5

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United States Patent Office 3,190,494 Patented June 22, 1965

3,190,494

METHOD AND APPARATUS FOR FILLING MOLDS WITH SLIP

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Filed Sept. 18, 1963, Ser. No. 309,615
9 Claims. (Cl. 222—1)

The present invention relates generally to slip casting of ceramic shapes. More particularly, the present invention relates to pouring slip into a mold for slip casting ceramic shapes. Specifically, the present invention relates to a gravitational pouring of slip into molds in such a manner that air is not entrained in the slip.

Slip casting of ceramic shapes has changed little over the past centuries. The use of forming means to cast shapes is ageless. If the cast article is to be made in any appreciable number, or if the article has any appreciable size, large areas have historically been required to accommodate not only the bulk of the mold means but also to permit access for the artisan to complete his endeavors.

Even today, many leading manufacturers of cast ceramic shapes utilize the mold means and space requirements of bygone days. With such an arrangement each molding means must individually be filled with slip and no matter whether the slip is ladled into the mold or is fed under pressure through a hose means, great care must be taken to assure that inclusion of air in the slip is not permitted, since this can cause a variety of faults in the casting. For example, large air bubbles reduce the internal strength of the casting and induce cracks, while smaller bubbles create what is known as "pin holes," or minute craters, in the finished glaze.

In my copending U.S. patent application, Serial No. 278,345, filed May 6, 1963, I disclose a system for slip casting ceramic shapes which obviates the excessive space requirements and localizes the slip pouring, or mold filling operation, to a particular station.

It is therefore an object of the present invention to provide an apparatus for pouring slip into a plurality of mold means without entrainment of air.

It is another object of the present invention to provide an apparatus adapted to receive slip from a supply source and meter out a predetermined amount to each of a plurality of mold means without entrainment of air.

It is a further object of the present invention to provide an apparatus, as above, which meters the slip and fills the mold means therewith by gravitation flow.

It is a still further object of the present invention to provide an apparatus for filling mold means, as above, which can be readily drained and flushed.

It is a still further object of the present invention to provide an apparatus for filling mold means, as above, which is economical both to produce and maintain.

These and other objects which will become apparent from the following specification are accomplished by means hereinafter described and claimed.

One preferred embodiment is shown by way of example in the accompanying drawings and hereinafter described in detail without attempting to show all of the various forms and modifications in which the invention might be embodied; the invention being measured by the appended claims and not by the details of the specification.

In the drawings:

FIG. 1 is a side elevation of a slip pouring apparatus according to the present invention disclosed in conjunction with the casting system of my aforementioned copending U.S. patent application Serial No. 278,345;

FIG. 2 is a top plan view of the slip pouring apparatus;

FIG. 3 is a front elevation of the slip pouring apparatus;

FIG. 4 is an enlarged fragmentary area of FIG. 3;

FIG. 5 is an enlarged cross section taken substantially on line 5—5 of FIG. 1; and,

FIG. 6 is an enlarged fragmentary area of FIG. 1.

In general, an apparatus according to the concept of the present invention, and capable of performing the process thereof, has a master reservoir adapted to hold a predetermined amount of liquid slip. The master reservoir is fed from a supply source in such a way that the slip enters the master reservoir below the surface of a residual volume of slip retained in the master reservoir from the preceding cyclic operation of the apparatus. A plurality of metering reservoirs are connected to the master reservoir by a feed line. An appropriate valve means in the feed line controls the flow from the master to the metering reservoirs, which is accomplished by gravity. Similarly, the slip enters the metering reservoirs from the feed line at a level below the surface of a residual volume retained in the metering reservoir. Each metering reservoir has a spout and a valve means by which slip exhausts into the mold means.

Referring more particularly to FIG. 1 of the drawings, the slip pouring apparatus, indicated generally by the numeral **10**, is shown positioned to fill a plurality of molds **11** carried on a carriage **12** of the type disclosed in my aforementioned U.S. patent application, Serial No. 278,345.

The slip pouring apparatus **10** may be dependingly supported from a truck **13** movable by wheels **14** along an overhead track comprised of parallel beams **15** and **16**.

A plurality of support rods **18** maintain the frame **19** of the apparatus **10** in spaced relation below the truck **13**. The frame **19** is comprised of a pair of spaced apart, substantially parallel, side members **20** and **21** secured to a spanning plate **22**, as by welding **23**. A pair of channels **24** and **25** form lateral extension members and are secured to the under side of the side members **20** and **21**.

A master reservoir **26**, preferably a large cylindrical drum, is mounted on the upper side of the spanning plate **22**. For convenience of access to the interior, it has been found desirable to provide the master reservoir **26** with a removable cap **28**. A supply line, or pipe, **29** is attached to the side wall **30** of the master reservoir **26** for communication with the interior thereof. A supply valve **31** is provided in supply line **29**.

One end of a feed line **32** also communicates with the interior of the master reservoir **26**. One segment of feed line **32** is formed from a drop pipe **33** which is secured to and extends downwardly from the base **34** of reservoir **26**. A drain valve **35** may be provided at the lower end of drop pipe **33** which, if it is made the lowest point in the flow system of apparatus **10** (as shown) can be used to drain all the slip from the apparatus.

Upwardly of the drain valve **35** a lateral pipe **36**, forming another segment of line **32**, extends between the drop **33** in a manifold, or header **38**. The header **38** extends substantially parallel to and below the lateral extension channels **24** and **25** of frame **19**. The interior of each of the plurality of metering reservoirs **39** communicates with the header by a coupler **40** which joins a downwardly directed stub **41**, forming the last segment of the feed line **32**, in the base **42** of the metering reservoirs **39** to an opposed, corresponding stub **43** extending upwardly from header **38**. The coupler **40** is connected to the stubs **41** and **43** by spring clips **44** and **45**, respectively.

Each of the metering reservoirs **39** is supported between the lateral extension channel **24** and **25** by one or more brackets **46** affixed between the side wall **48** of the metering reservoir and the lateral extension channels **24** and **25**.

A feed valve **49** is provided in the feed line **32**, as for example in drop pipe **33**, as shown.

It has also been found desirable to provide each meter-

ing reservoir 39 with a cap 50 for ready access to the interior, as when repairing or cleaning.

A spout 51 extends downwardly and outwardly from the side wall 48 of each metering reservoir 39 upwardly from and in proximity to the base 42. By thus causing the spout 51 to intersect the side wall 48 at an acute angle, preferably at approximately 45° (as shown best in FIG. 6) entrapment of air within the spout 51 during the operation of filling the metering reservoir 39 is prevented, as will be more fully hereinafter explained.

A discharge valve 52 is attached to each spout 51. The weight of the valves 52 may best be supported on a mounting bar 53 dependingly supported from the lateral extension channel 24 by inner and outer struts 54 and 55, respectively.

The discharge valve 52 is preferably of the pinch tube variety, as shown in FIG. 5, which has a flexible conduit or hose, identified as valve tube 56. One end of the valve tube 56 is connected to the end of spout 51. The other end is connected to a nozzle 58. A fixed backup plate 59 on one side of the valve tube 56 is opposed by a movable actuator bar 60.

Such a valve 52 may be either of the normally open or normally closed type. As shown, the actuator bar 60 is biased away from the backup plate 59 by a spring 61 to maintain the valve tube 56 in its unactuated open position. A lever 62, pivotally actuated by a solenoid 63 forces the actuator bar 60 toward the backup plate 59 to close the valve as long as the solenoid 63 is energized.

In actual operation the supply valve 31 would be open to permit the slip to enter the master reservoir 26. Because of the location of the supply pipe 29 in close proximity to the base 34 of the master reservoir 26, the slip from the pipe 29 will flow into the slip within the master reservoir without entraining air. When a predetermined amount of slip has entered the master reservoir 26, a propitiously located liquid actuated limit switch 64 (FIG. 1) near the top of the master reservoir 26 is wired to close supply valve 30. Then, with the discharge valve 52 and the drain valve 35 as well as the supply valve 31 all closed, the feed valve 49 is opened to permit the slip in the master reservoir 26 to flow, by gravity, into the metering reservoirs 39 via feed pipe system 32. Here again the slip enters the bottom of the metering reservoirs 39 and the flowing liquid is thus prevented from entraining air.

As can best be seen in FIG. 1, the amount of slip which it takes to fill the master reservoir 26 is predetermined to equal that required to fill the plurality of metering reservoirs 39 so that when the upper surface 64 of the slip in the metering reservoirs 39 is on the same level as the upper surface 65 of the residual volume of slip in the master reservoir 26 the flow will cease with the proper amount of liquid slip in each of the metering reservoirs 39.

After the metering reservoirs 39 are thus filled the feed valve 49 is closed. It will be observed that the supply pipe 29 enters the master reservoir 26 on a level lower than the surface 65 of the residual volume of slip retained in the master reservoir.

After the feed valve 49 has been closed, and with the molds properly positioned with respect to the nozzles 58, the discharge valves 52 are opened to permit the slip to flow out of the metering reservoirs 39 through the spouts 51, valve 52 and nozzles 58 into the mold. The metering reservoirs 39 are of such dimension that the volume of the fluid slip between the upper surface 64 and the upper surface 66 of the residual volume retained in the metering reservoirs 39 will completely fill the mold.

Referring particularly to FIG. 6, it should now be apparent how the acute angularity between the spout 51 and the side walls 48 of the metering reservoirs 39 prevent entrapment of air. Specifically, as the metering reservoir is filled the upper surface 66 raises past the lowermost edge 68 of the juncture between the spout 51 and the side wall 48 and the slip will flow down the lower portion of the spout 51 to the closed discharge valve 52. Thereafter, the slip quickly fills the spout 51 so that as the level of the fluid slip in the metering reservoir 39 raises past the uppermost edge 69, the level of the slip in the spout will be the same as that in the reservoir and the air is forced out without entrapment.

To empty all the slip from the apparatus the drain valve 35 need only be opened and all the slip in the system will flow out into the receiving end 68 of the drain pipe 69 connected to the drainage system beneath the floor 70. The apparatus may be flushed with water, as desired. Particular attention should be paid to the spouts 51 and discharge valves 52 since they will not drain back into the metering reservoirs 39 for emptying through the drain valve 35.

An apparatus according to the present concept restricts all the slip flow therein to an homogeneous conversion of the elevation heads. That is, there is no pouring or turbulence in the presence of air which can permit entrainment of air from the time the slip enters the apparatus, during the time it is gravitationally metered into a plurality of requisite volumes, and until it is discharged from the apparatus.

Furthermore, the efficiency of such an apparatus with regard to metering and pouring time, size and the number of molds it can simultaneously charge, even apart from its low initial and maintenance costs, are all positive factors which enhance this apparatus, capable of metering and pouring slip without entrainment of air, to the industry.

It should thus be apparent that this apparatus accomplishes the objects of the invention.

What is claimed is:

1. An apparatus for simultaneously pouring liquid slip into a plurality of mold means for slip casting ceramic shapes comprising, a plurality of metering reservoirs, each said metering reservoir having a side wall, a spout extending outwardly and downwardly from said side wall and communicating with said reservoir, said spout discharging slip from said metering reservoir by gravity, a valve means on each said spout for controlling the flow from said metering reservoir, a feed pipe for supplying liquid slip upwardly into each said metering reservoir, said feed pipe communicating with each said metering reservoir on a level lower than said spout.

2. An apparatus for simultaneously pouring liquid slip into a plurality of mold means for slip casting ceramic shapes comprising, a plurality of metering reservoirs, each said metering reservoir having side walls and a base, a discharge spout for each metering reservoir, each said spout communicating with the interior of its respective metering reservoir through a side wall, each said spout oriented downwardly and outwardly of its respective metering reservoir in an angularly inclined relation thereto, a valve means on each spout, a feed pipe for supplying liquid slip upwardly into each said metering reservoir, said feed pipe communicating with each said metering reservoir on a level lower than the communication of the spout with said metering reservoir.

3. An apparatus for simultaneously pouring liquid slip into a plurality of mold means for slip casting ceramic shapes comprising, a plurality of metering reservoirs, each said metering reservoir having side walls and a base, a discharge spout for each metering reservoir, each said spout communicating with the interior of its respective metering reservoir through a side wall, each said spout oriented downwardly and outwardly of its respective metering reservoir, a valve means on each spout, a feed pipe for supplying liquid slip upwardly into each said metering reservoir, one end of said feed pipe communicating with each said metering reservoir on a level lower than the communication of the spout with said metering reservoir, a master reservoir, the other end of said feed pipe communicating with said master reservoir, said mas-

ter reservoir positioned on a level with respect to said metering reservoirs such that slip will flow from said master reservoir to said metering reservoirs by gravity, and a valve means in said feed pipe to control the flow from said master reservoir to said metering reservoir.

4. An apparatus for simultaneously pouring liquid slip into a plurality of mold means for slip casting ceramic shapes comprising, a plurality of metering reservoirs, each said metering reservoir having at least one side wall and a base, a discharge spout for each metering reservoir, each said spout communicating with the interior of its respective metering reservoir through a side wall, each said spout oriented downwardly and outwardly of its respective metering reservoir, a valve on each spout, one end of a feed pipe communicating with each said metering reservoir on a level lower than the communication of the spout with said metering reservoir, a master reservoir, the other end of said feed pipe communicating with said master reservoir, a valve in said feed pipe, said master reservoir having a capacity substantially equivalent to the summation of the capacities of said metering reservoirs, a supply means for filling said master reservoir, said master reservoir being so positioned with respect to the individual metering reservoirs that a preselected quantity of slip is available in each of said metering reservoirs when the upper surface of the slip in said metering reservoirs is on the same level as the upper surface of a residual volume of slip in said master reservoir, drain means in said feed line for emptying said apparatus.

5. A slip filling apparatus, as set forth in claim 4, in which the master reservoir is filled by a supply pipe entering said master reservoir on a level lower than the lowest level of the slip in said master reservoir when the levels of the slip in said metering reservoirs in said master reservoirs are the same.

6. A method for simultaneously pouring slip into a plurality of mold means for slip casting ceramic shapes comprising the steps of, filling a master reservoir with a predetermined amount of liquid slip from a level below the level of a residual volume of slip retained in said master reservoir, gravitationally draining all but said residual volume from said master reservoir into a plurality of metering reservoirs each from a level below the level of a residual volume of slip retained in each metering reservoir, gravitationally draining all but the residual volume in said meter reservoirs simultaneously into a plurality of mold means.

7. A method for simultaneously pouring slip into a plurality of mold means for slip casting ceramic shapes comprising the steps of, filling a master reservoir with a predetermined amount of liquid slip from a level below the level of a residual volume of slip retained in said master reservoir, gravitationally draining all but said residual volume [illegible] then upwardly [illegible] reservoirs, gravita[illegible] voirs simultaneously into a plurality of mold means.

8. A method for simultaneously pouring slip into a plurality of mold means for slip casting ceramic shapes comprising the steps of opening a supply valve on a feed line to fill a master reservoir with a predetermined amount of liquid slip from a level below the level of a residual volume of slip in said master reservoir, closing said supply valve, opening a feed valve on a feed line communicating between the master reservoir and a plurality of metering reservoirs to drain, by gravity, the liquid slip in said master reservoir through the bottom of said master reservoir and then upwardly into the bottom of a plurality of metering reservoirs until the level of the upper surface of the slip in said metering reservoirs is on the same level as the upper surface of the residual volume of slip in said master reservoir, closing said feed valve, opening a discharge valve on each of said metering reservoirs gravitationally to drain a predetermined amount of slip from said metering reservoirs into a plurality of molds.

9. An apparatus for simultaneously pouring liquid slip into a plurality of mold means for slip casting ceramic shapes comprising, a plurality of metering reservoirs, each said metering reservoir having a discharge spout communicating therewith for discharging slip from said metering reservoir by gravity, a valve means on each said spout for controlling the flow from said metering reservoir, a feed pipe for supplying liquid slip upwardly into each said metering reservoir, said feed pipe communicating with each said metering reservoir on a level lower than said spout, a master reservoir, the other end of said feed pipe communicating with said master reservoir, a valve means in said feed pipe, means for selectively opening and closing the valve in said feed pipe, master reservoir having a capacity substantially equivalent to the summation of the capacities of said metering reservoirs and being so positioned with respect to the individual metering reservoirs that a preselected quantity of slip is available in each said metering reservoir when the upper surface of the slip in said metering reservoirs is on the same level as the upper surface of a residual volume of the slip in said master reservoir.

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