

June 22, 1965

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3,189,971

SYSTEM FOR SLIP CASTING HOLLOW CERAMIC SHAPES

Filed May 6, 1963

6 Sheets-Sheet 1

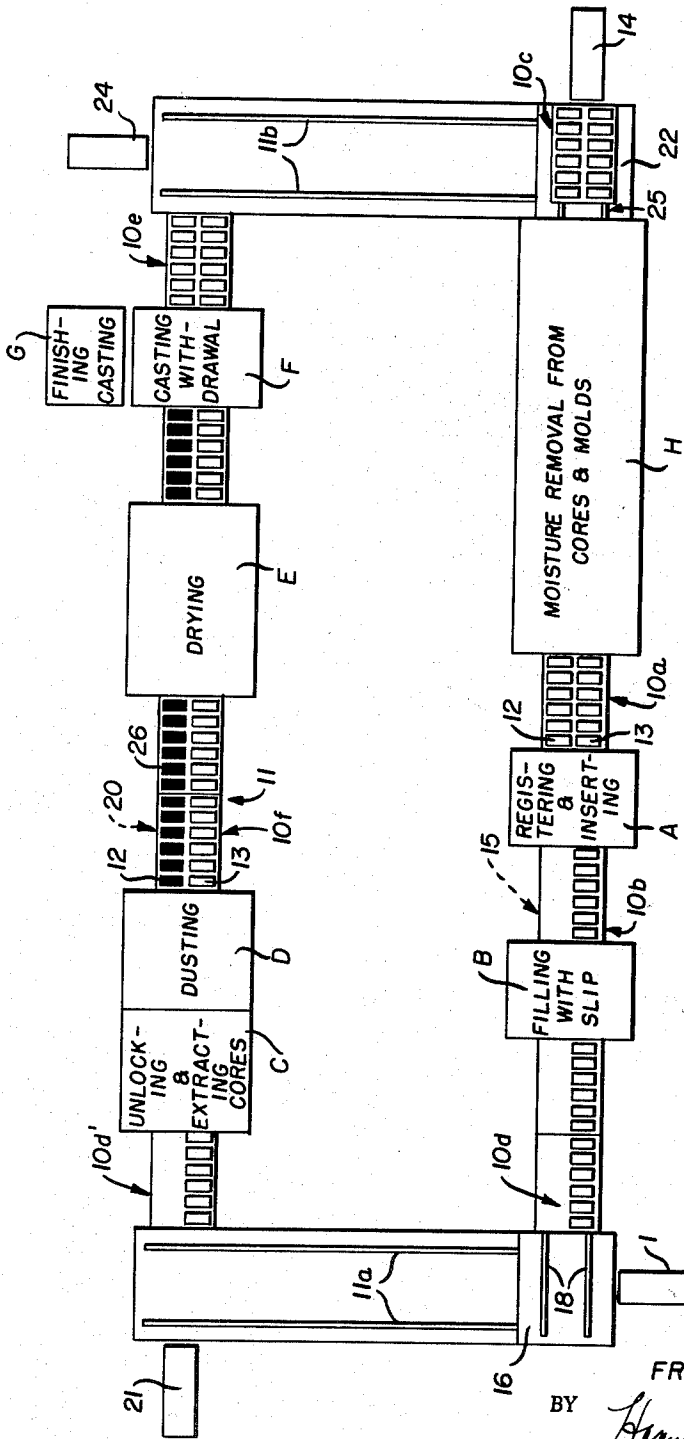


FIG. 1

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6 Sheets-Sheet 2

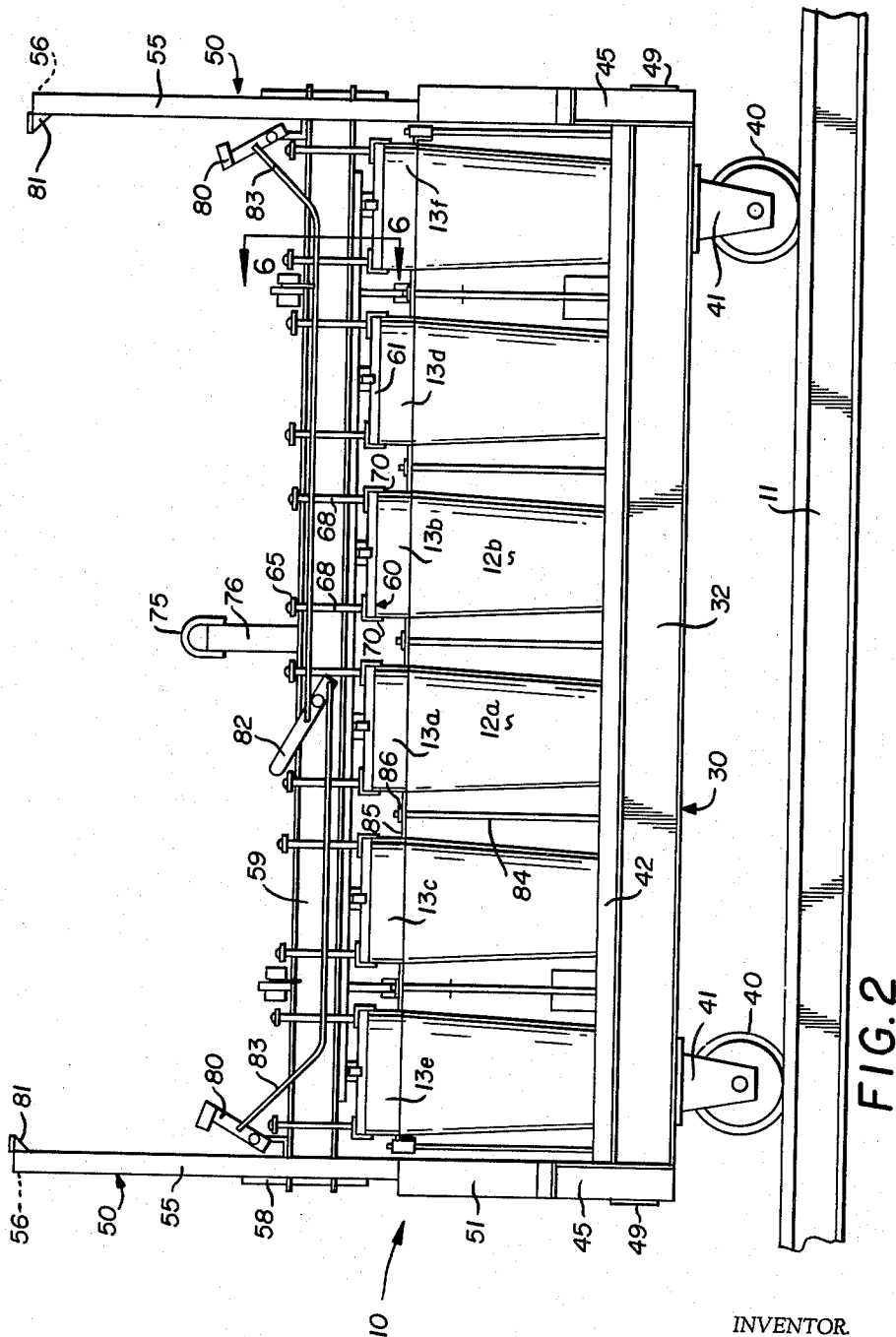


FIG. 2

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6 Sheets-Sheet 3

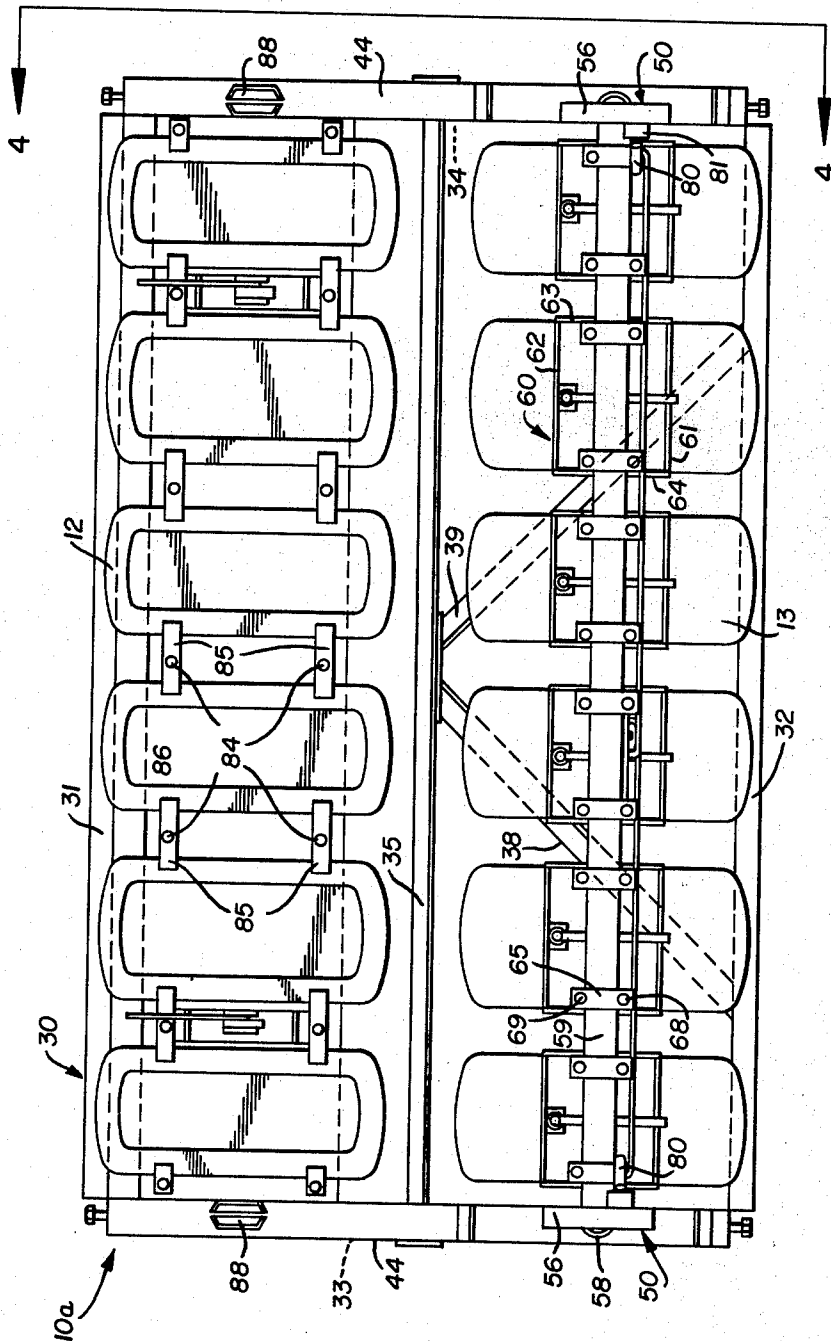


FIG. 3

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SYSTEM FOR SLIP CASTING HOLLOW CERAMIC SHAPES

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6 Sheets-Sheet 4

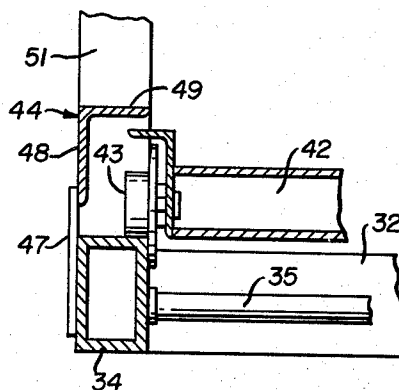


FIG. 5

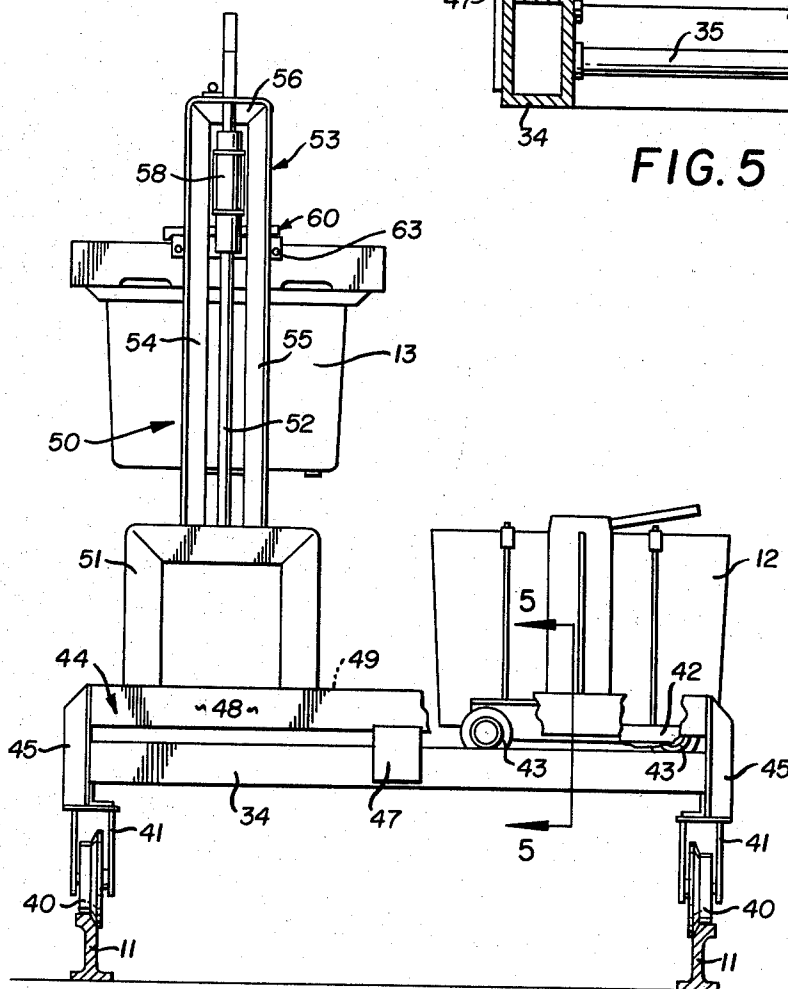


FIG. 4

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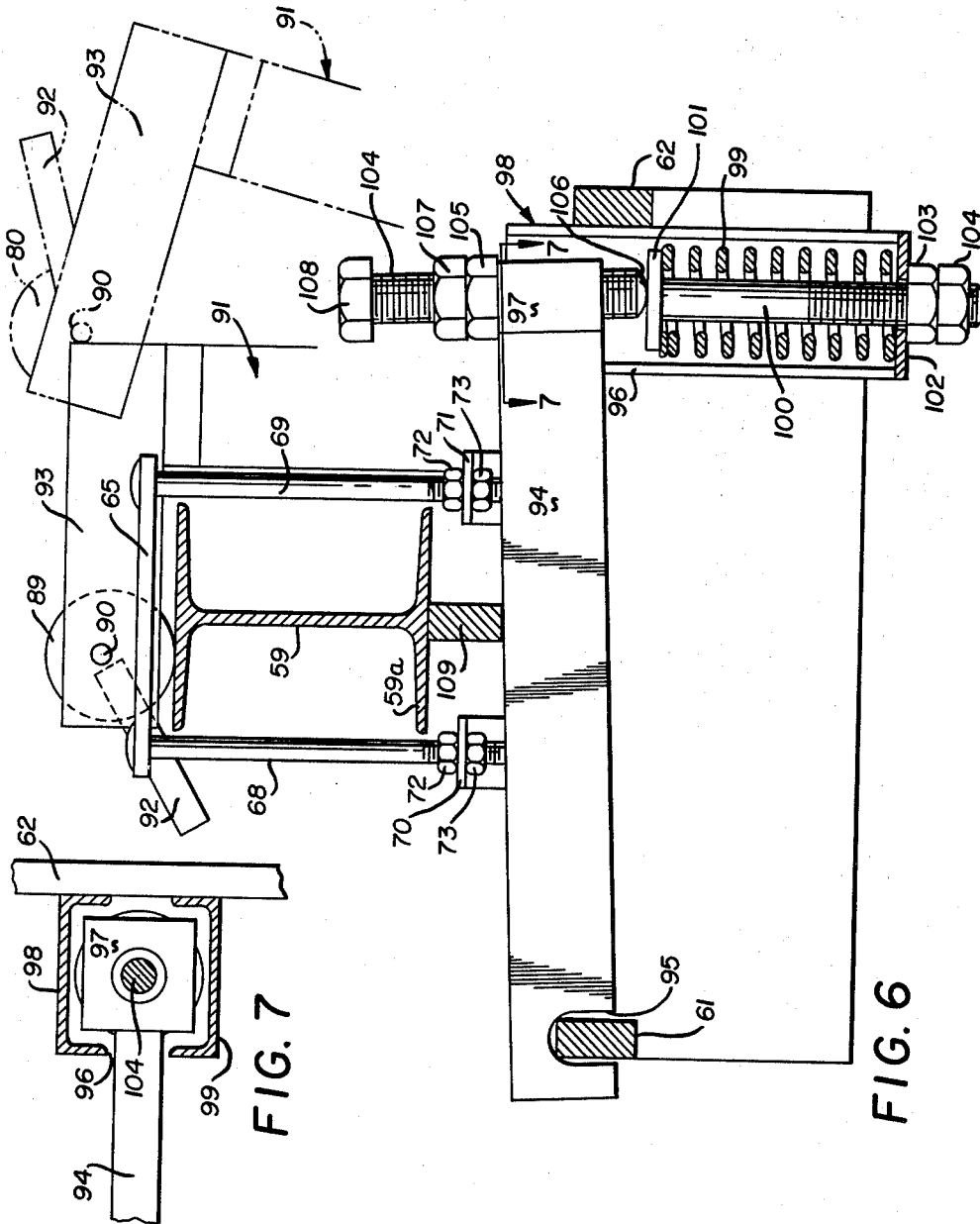
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6 Sheets-Sheet 5



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6 Sheets-Sheet 6

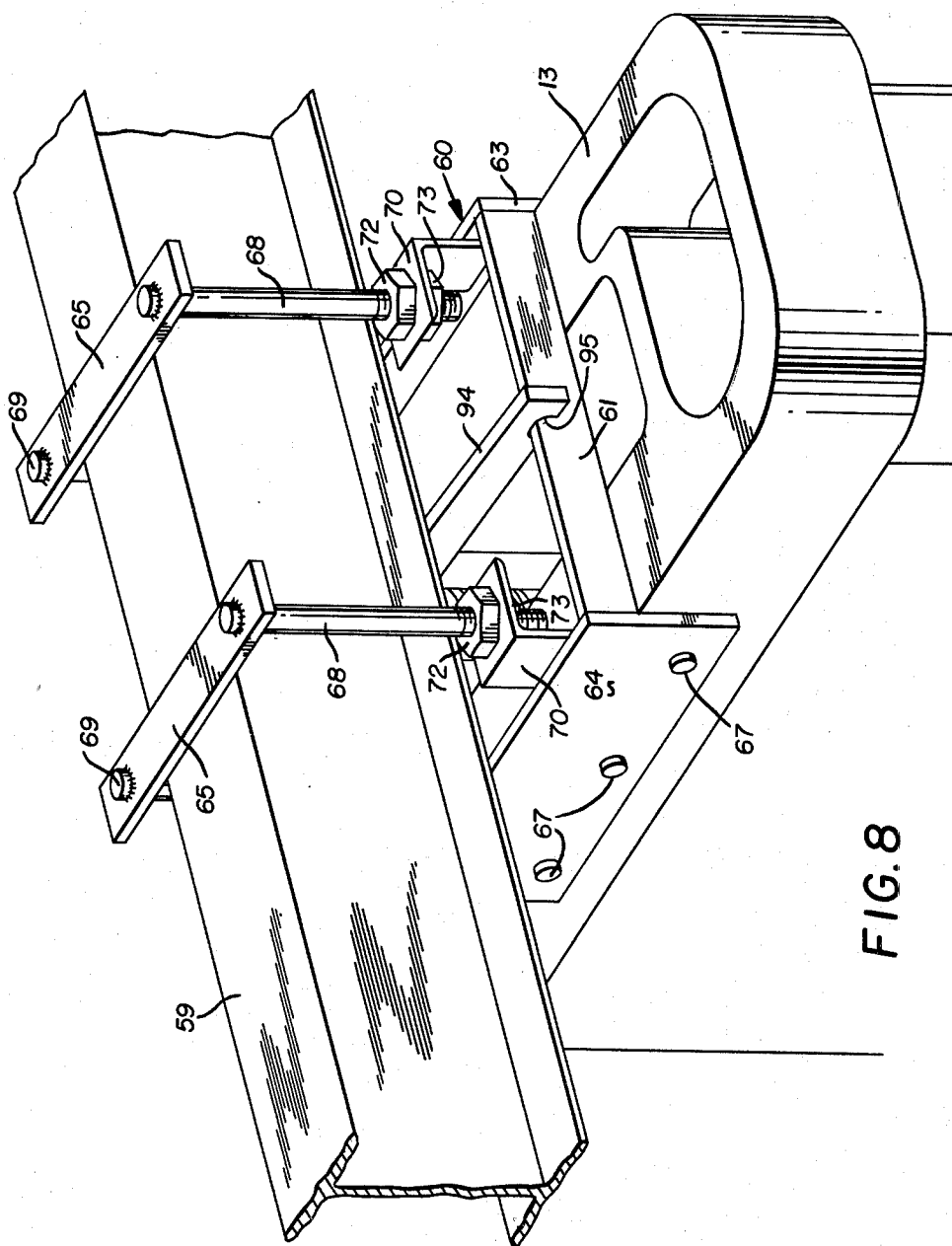


FIG. 8

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SYSTEM FOR SLIP CASTING HOLLOW CERAMIC SHAPES

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Filed May 6, 1963, Ser. No. 278,345
15 Claims. (Cl. 25—29)

The present invention relates generally to an improved system for the manufacture of slip cast, hollow, ceramic shapes. More particularly, the present invention relates to a system for slip casting hollow, ceramic shapes in which the various steps of the process are sequentially performed at individual stations. Specifically, the present invention relates to an improved system for slip casting hollow, ceramic shapes which employs a novel carriage to move the forming means by which the ceramic shapes are cast from station to station throughout the system.

Prior known methods of slip casting hollow, ceramic shapes have changed little over the past centuries. The use of forming means, such as cores and molds, to cast hollow objects is ageless. However, spacious areas are required for casting and drying if a shape has any appreciable size and is to be made in any appreciable number.

Excessive floor space has heretofore been required not only to accommodate the bulk of the molds and cores but also to permit access to each mold for insertion and removal of the core, as well as sufficient room for the artisan to dust the molds and cores, pour the slip, withdraw the green castings from the molds, and perform certain steps required to prepare the casting before it is sent to the finishers for smoothing, deburring, and glazing just prior firing in the ovens.

It is therefore an object of the present invention to provide a system for slip casting ceramic shapes requiring the minimum space wherein each operation in the manufacture of the hollow ceramic shape preferably takes place at an independent station.

It is also an object of the present invention to provide a system for slip casting hollow ceramic shapes which reduces both the amount of scrap articles and the number of artisans required.

It is another object of the present invention to provide a carriage supporting a plurality of molds and cores for transporting the molds and cores to successive stations throughout the system.

It is still another object to provide a carriage for supporting multiple molds and cores lockingly insertable therein to withstand the hydraulic pressure of the liquid slip.

It is a further object of the present invention to provide a carriage, as above, which permits simultaneous extraction of all the cores after progressive and stabilized release in order to lower the release loading and prevent injury to the green casting.

It is a still further object of the present invention to provide a carriage which, although it is adapted for progressive release of the cores from the molds, exerts an equal pressure on each core as it locks them into their respective molds.

It is a still further object of the present invention to provide an improved system for slip casting hollow ceramic shapes wherein successive carriages transverse a closed circuit to complete the casting operation.

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

One preferred embodiment of the present invention is shown by way of example in the accompanying drawings and described in detail without attempting to show all of the various modifications in which the invention

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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 schematic plan view of an installation of a system embodying the concept of the present invention for slip casting hollow ceramic shapes;

FIG. 2 is a side elevation of the novel mold and core supporting carriage utilized in the improved system for slip casting hollow ceramic shapes depicting the cores lockingly inserted in the molds;

FIG. 3 is a top plan of the carriage shown in FIG. 2 depicting the molds and cores vertically and laterally displaced from each other;

FIG. 4 is an end elevation taken substantially on line 4—4 of FIG. 3; and

FIG. 5 is an enlarged cross-sectional view taken substantially on line 5—5 of FIG. 4.

FIG. 6 is an enlarged cross-sectional view taken substantially on line 6—6 of FIG. 2;

FIG. 7 is a further cross section taken substantially on line 7—7 of FIG. 6; and

FIG. 8 is a perspective view of the yoke assembly and connecting means by which the core is dependently mounted.

In general, a carriage according to the present invention comprises a frame mounted for travel on a trackway. The frame is preferably rectangular with four wheels mounted thereon for supporting said carriage to move longitudinally of said frame. A mold table of approximately one-half the width of the carriage is supported on and carried by the frame so as to be laterally translatable thereon. A plurality of molds are mounted on the table and movable therewith. The cores corresponding to the molds are jig suspended for selective vertical positioning by a head bar extending longitudinally above the table between vertical stanchion means located at opposed longitudinal ends of the frame. The head bar is slidable on the vertical stanchion means by a lineal bearing housing at each end of the head bar. The mold cores are suspended on the head bar to permit simultaneous insertion into and extraction from the molds after a progressive and stabilized release. The head bar may be locked in its "up" position to permit the mold carrying table to move laterally of the carriage in order to move the molds laterally into and out of registry with said cores without interference to the molds by the dependently supported mold cores.

The construction of the head bar connecting structure whereby the cores are mounted thereon assures that the head bar exerts an equal pressure on each core as it is locked into its respective mold.

In the improved system a plurality of carriages are movable along a closed circuit trackway for selective positioning at the various sequentially located stations: e.g., where the core is inserted into the mold, the mold is filled with slip; the cast takes place; the core is removed; the core is dusted; the hollow shape is further dried; the green casting is removed from the mold; and the core and mold are dried prior to recycling through the system.

Referring particularly to FIG. 1, the improved system utilizes a plurality of new and improved carriages, each indicated generally by the numeral 10, movably mounted on a track 11 arranged in a closed path. The carriages 10 are movable along the closed path of track 11 between a successive series of stations where various operations are performed to slip cast hollow ceramic objects.

Each of the carriages 10, as will be hereinafter more fully described, carries a balanced plurality of cores and interfitted molds relatively vertically and laterally movable with respect to each other. The carriage 10a de-

picted in FIGS. 1 and 3 represents the molds 12 vertically and laterally displaced from the cores 13. At station A means are provided for moving said molds 12 into registry with said cores 13 and inserting said cores into said molds. The carriage 10b represents a carriage having left station A with the cores and molds interfittingly locked.

At station B the void between the molds and their inter-fitted cores is filled with slip. To traverse between the successive stations such as stations A and B, it has been found that the most efficient operation of the improved system is obtained when the closed path of track 11 is arranged in rectilinear form, such as shown in FIG. 1. The stations at which the individual operations incident to slip casting hollow ceramic shapes are performed can then be positioned advantageously along those portions of the track forming the two opposed longer sides of the rectilinearly shaped path. Furthermore, if the carriages are positioned in abutting relation along those two sides only a simplified prime mover need be associated with each side. From FIG. 1 it can be observed that a force applied to carriage 10c by the mover 14 will advance every carriage 10 on side 15 of the rectilinear track 11. This mover 14 may incorporate an extensible piston means, not shown, which, upon activation of the mover, will directly engage not only carriage 10c but will move all the carriages 10 on side 15 the length of one carriage. This will place the carriage 10d on the transfer dolly 16.

Dolly 16 has a pair of tracks 18 aligned with the tracks forming the side 15 and on which the carriage 10d is received. The dolly 16 also has wheel means, not shown, to permit the dolly to traverse, in either direction, as desired, tracks 11a which form one end of the rectilinear track 11. A suitable mover 19, similar to mover 14, may be employed to shuttle the dolly 16 back and forth along the track 11a with the tracks 18 aligning with those forming the sides 15 and 20 of the rectilinear track 11 at each end of the shuttle movement. A third mover 21, also similar to mover 14, may, when the tracks 18 are aligned with those forming side 20, move the carriage 10d off dolly 16 onto that portion of the tracks forming the side 20, i.e., to the position 10d'. With the carriages also positioned on side 20 in abutting relation, this movement advances all the carriages on side 20 the length of one carriage. This in turn moves carriage 10e onto dolly 22 for transfer across track 11b. Of course, after carriage 10c has been removed from dolly 22 by the action of mover 14, as described above, the dolly 22 would have been returned via tracks 11b by mover 24 so that it was aligned with side 20 in order to receive the carriage 10e on its tracks 25. The coordinated operations of movers 14, 19, 21 and 23 can be cyclically coordinated with each other and with the time required at each station to advance the abutted carriages from station to station in order to accomplish the steps necessary to slip cast hollow ceramic shapes.

When the successive carriages 10 are moved to station C the cores are unlocked and extracted from the molds which retain the newly formed casting. The time cycle for moving the carriages between stations B and C is coordinated with the distance between stations B and C to permit the liquid slip to "cast," i.e., to lose its fluidity.

The carriage is so constructed as to facilitate removal of the cores without damaging the casting. This aspect is described hereinafter in detail.

After removal, the cores are dusted to minimize the adhesion between them and subsequently formed casting produced in successive recyclings through the system. This dusting can be performed by mechanical means operated in conjunction with and at the same station as the core removal, or, as shown, at a successive station D. In order to facilitate dusting of the cores, the cores and molds are laterally as well as vertically offset with respect to each other, as represented by carriage 10f in FIG. 1.

Thereafter, the carriages 10 with the castings 26 and

the molds 12 are moved through a drying station E to the casting removal station F. By the time the carriages 10 reach station F the castings have been green cured sufficiently to shrink away from the porous mold wall and can be carefully withdrawn without deformation.

A station G is preferably provided adjacent the casting withdrawal station F where the green cured castings are smoothed, deburred and stacked to await glazing and firing while "white curing." After the castings have been removed from the molds the carriages continue to station H where the moisture is removed from the cores and molds prior to recycling.

Referring more particularly to FIGS. 2-5, the carriage 10 has a frame 30 which is preferably of rectangular shape with longitudinal side members 31 and 32 joined by laterally extending box-shaped primary end members 33 and 34. Suitable structural stiffening members, such as the longitudinally aligned center bar 35 connected between end members 33 and 34 and the cross braces 38 and 39 joined between the side member 32 and the center bar 35, are desirable to impart rigidity to the frame. Wheel means such as the wheels 40 rotatably mounted in each of the brackets 41 dependently secured to the under portion of the frame 30 at each of the four corners thereof, are provided to permit the carriage 10 to be moved longitudinally along the track 11.

A table 42 having approximately one-half the width or lateral dimension of the frame 10 is mounted on the upper side thereof. At each longitudinal end of the table 42 are a pair of flanged wheels 43 which rollingly engage the upper surfaces of the primary end members 33 and 34 to permit the table 42 to be moved laterally from one side of the frame to the other.

An upward extension of the frame is provided at each longitudinal end of the frame. Each frame extension comprises a secondary end member 44 which is secured to frame 30 so as to lie parallel to and above the primary end members 33 and 34. As shown most clearly in FIG. 4, each secondary end member 44 is secured to the frame by vertical posts 45 which are connected to the frame at each corner. Adequate clearance for the flanged wheels 43 may be afforded by constructing the secondary end member 44 in the shape of an angle iron having vertically and horizontally disposed flanges 48 and 49, respectively. The horizontal flanges 49 is spaced above the end members sufficiently to provide a vertical clearance for wheels 43 and the vertical flange 48 is aligned with the outer side of the end member to give horizontal clearance for the wheels 43. A stiffening plate 47 is connected between the medial portions of the primary end member and the corresponding secondary end member to provide added stability to the secondary end member.

A stanchion means, indicated generally by the numeral 50, extends upwardly from each secondary end member 44. The stanchions 50 are longitudinally aligned and are each positioned laterally inwardly from longitudinal side members 31 approximately one-quarter of the lateral dimension of the frame 30 to permit the table 42 to be centered on the stanchions when positioned at one side of the frame and to be completely clear thereof when positioned on the laterally opposite side of the frame.

In the embodiment depicted in the drawings, each stanchion 50 has a base bracket 51 generally in the shape of an inverted U secured to the upper side of the secondary end member 44. Extending vertically upwardly from the base bracket 51 is a bearing slide shaft 52. The vertical slide shaft 52 is rigidly supported at its uppermost extremity by an inverted U shaped brace 53, also extending upwardly from the base bracket 51, with legs 54 and 55 parallel to and positioned on either side of the shaft 52 and the cross bar 56 of the U secured to the shaft 52.

Slidably embracing each shaft 52 is a lineal bearing housing 58, one of which is attached to each end of the head bar 59. The head bar 59 is aligned longitudinally of the carriage between the stanchions 50 and is, in the

preferred embodiment, constructed of a wide flange beam (FIG. 6) to obviate deflection, especially in the herein-after described core extraction or locking process.

Dependingly supported from the head bar 59 are a plurality of cores 13 hung in balanced pairs. A yoke 60 is secured to the upper portion of each core. As shown in FIGS. 6 and 8, each yoke 60 is rectilinearly, or squarely, constructed with two opposed sides 61 and 62 of bar stock and the other two opposed sides 63 and 64 of plate stock. The plate sides 63 and 64 extend downwardly along opposite sides of the upper portion of the core and are attached thereto by suitable pins 67. The bar sides 61 and 62 extend across and contact the uppermost edges or surfaces of the core. Connecting means independently interconnect each yoke 60 to the head bar 59.

As best shown in FIGS. 6 and 8, the connecting means comprises top plates 65 which extend across the top of the head bar 59 and have a bore at each end to permit two bolts 68 and 69 to extend therethrough closely along the outer edges of the flanges of the head bar 59. Beneath the head bar 59 the bolts extend through, and are bolted to, individual flanges 70 and 71, respectively, of angles secured to the plate sides 63 and 64. That portion of the bolts 68 and 69 extending through flanges 70 and 71 are threaded to permit adjustment of upper and lower adjusting nuts 72 and 73 on each bolt above and below the flanges, respectively.

It has been found that the proper adjustment of these nuts greatly facilitates extraction of the cores from the molds. As is shown in the side elevation of FIG. 2, six cores are dependingly supported from the head bar 59. While six cores provide the most efficient operation, any number may be used, so long as the cores are dependingly supported in balanced pairs, i.e., the cores are mounted in pairs in equal increments of distance from the resultant of the vertical extraction force and each of said pairs is mounted to be engaged by the upward movement of the head bar 59 at different points in its upward travel. In the preferred embodiment a lift ring 75 is provided on lift bar 76 attached to the head bar 59. Thus, the application of the extracting or upward lifting force acts at the center of the longitudinally aligned head bar 59. The cores 13a and 13b are hung in balanced pairs, as are cores 13c and 13d, as well as cores 13e and 13f. That is, core 13a is positioned an equal incremental distance from the center of the head bar as is core 13b; cores 13c and 13d are also an equal distance from the center; and, cores 13e and 13f are likewise an equal distance. Moreover, the connecting means for cores 13a and 13b are carefully adjusted, by nuts 72 and 73, to hang an equal distance below the head bar 59.

As shown in the drawing of FIG. 2, when the cores are inserted in their respective molds 12, mounted on table 42, as hereinafter more fully described, the top plates 65 on the connecting means for cores 13a and 13b are exactly the same height above the top of the head bar 59. Similarly, the top plates 65 of the connecting means for cores 13c and 13d are the same height as each other but at different heights than the top plates for connecting means for the cores 13a and 13b. Furthermore, the top plates 65 of the connecting means for cores 13e and 13f are at the same height as each other but at different heights than either the top plates of the connecting means for cores 13a and 13b, or the cores 13c and 13d. Thus, when the head bar is lifted to extract the cores from the molds and newly formed castings according to the present system, the cores 13a and 13b will release first, then cores 13c and 13d, followed by cores 13e and 13f. Thereafter, they will all be simultaneously lifted out. This prevents binding and the necessity to overcome a high release loading, both of which often result in damage or other deformation to the green castings. When the cores have been lifted to a height sufficient to clear the molds—i.e., to the "up" position of the head bar 59, a latch bar 80 on each end of the head bar 59 will be moved to engage the

lock plate 81 attached to the cross bar 56 in the U shaped based 53 of stanchion 50. The latch bars 80 are operated by partially rotating a lock control lever 82, rockingly mounted on the head bar 59 to actuate the connecting rods 83 leading to the two latch bars 80.

Although the balanced pair concept has been explained with a central force application and with an even number of molds, it is readily apparent that an odd number of cores could also be utilized. In that event the odd core would be positioned in line with the resultant of the extracting force and the remainder would be paired as described above. Moreover, the application of the extracting force need not be a single force supplied at the resultant but could well be applied at more than one point.

The molds 12 corresponding to and into which the six cores 13 are inserted, are all carried on laterally positionable table 42. The molds 12 are affixed to the table 42 by a plurality of tie rods 84. The base of each rod 84 is secured by suitable means, not shown, to the table itself and the rods extend upwardly between adjacent molds to a point just above the upper edges of the molds. A plate 85 is associated with each tie rod 84. The rod 84 extends through the plate 85 and receives a nut 86 which can be tightened to apply downward pressure against the plate. Each plate 85 bridges between the top edges of adjacent molds and are used in a sufficient number to prevent the mold from lifting off the table 42 during the core extraction procedure described above.

Furthermore, it is desirable to position each mold so that the interfitted core is properly received therein. A uniformity in the positioning of all the molds can be established by employing a simple layout jig means, not shown. This layout can be uniform with respect to the carriage itself by employing the two throated guide means 88 extending upwardly from the secondary end member 44 at each end of the carriage 10. These guides 88 can receive a positioning structure on the jig and thus orient the jig to the carriage in a predetermined manner.

A hoist means similar to that utilized to raise the head bar 59 to the "up" position depicted in FIG. 4 can also be used to lower the head bar to the "down" position of FIG. 2. First, the table 42 is rolled laterally of the frame, so that the cores and molds are vertically aligned. Then the latch bars 80 are released by lock control lever 82, and the head bar 59 is lowered to insert the cores 13 into their respective molds 12.

When the cores are inserted in their respective molds, the head bar is locked into down position. This locking is accomplished by a pair of hand operated eccentric clamps 89 which act against the top of the head bar 59. The clamps 89 are each rotatably mounted on a pin 90 extending laterally from a hooked bar 91 anchored to table 42. A hand lever 92 provides sufficient leverage for manual operation of each clamp 89.

The hooked bar 91 is pivotally attached to the table 42 or hinged in a well-known manner to permit the hook 93 and the clamp 89 attached thereto to be pivoted rearwardly to the position shown in phantom (FIG. 6) in order to permit the head bar to be raised and lowered without interference.

Because of the hydraulic pressure created by the liquid slip which is used to fill the space between the interfitted mold and core, the locking pressure developed by the clamp 89 must be quite large. Furthermore, the contact surface between the molds and cores must be sealed to prevent leakage of the slip before it has cast. This, too, requires a rather heavy locking pressure. Yet, these pressures can not be excessive on any one or more of the plaster cores or they will break.

The cores can not be economically manufactured to close tolerances to assure uniformity of locking pressure. Therefore, when a plurality of cores are locked by a common clamping means a wide variance is found in the pressure exerted thereby against the individual cores.

This variance has been eliminated in the subject carriage.

A pressure beam 94 is interposed between each yoke 60 and the head bar 59. Specifically, the pressure beam 94 is disposed transversely to the head bar and extends between the bar members 61 and 62 of the yoke 60. A notch 95 at one end of the beam 94 engages bar 61 and permits the beam 94 to pivot thereon. The hub end 97 of beam 94 extends through a guideway 96 into a housing 98 attached to the other bar member 62. Within housing 98 is a compression spring 99 which is coiled about a vertically oriented threaded bolt 100. The compression spring 99 is confined between the head 101 of bolt 100 and a keeper plate 102 fixed to the underside of housing 98. An adjusting nut 103 and a locking nut 104 are carried on the threaded portion of bolt 100 which extends below keeper plate 102 to permit pre-loading of the spring between the head 101 and keeper plate 102 by adjustment of nut 103.

A set bolt 104 is threaded through a nut 105 welded to the upper side of the hub end 97 of beam 94. The lower extremity 106 of bolt 104 is adapted to extend below the hub end 97 and contact the head 101 of bolt 100. A lock nut 107 is carried on the threaded portion of set bolt 104 above the hub end 97 of beam 94. The vertical position of set bolt 104 can be adjusted by turning head 108, after which tightening lock nut 107 against nut 105 assures that the lower extremity 106 of bolt 104 will remain a selected extending distance below the hub end 97.

A keel bar 109 is affixed to the lower flange 59A of head bar 59 along substantially the entire length thereof and extends below the lowermost level at which any of the brackets 70 and 71 on yoke 60 of the balanced pairs of cores will be positioned in order to provide an assured obstruction-free contact with the pressure beam 94 on all the yokes.

The set bolt 104 through the hub end 97 of each beam 94 compensates for any variation in the over-all height of the individual molds 12 comprising the plurality thereof carried on carriage 10. Thus, when the cores 13 are inserted in their corresponding molds 12, the tightening of the eccentric clamps 89 against head bar 59 causes an equal additional locking pressure to be imparted to the pre-compressed spring 99 associated with each core as the keel 109 applies downward pressure to each beam 94.

It should be apparent from the foregoing description that a system for slip casting hollow ceramic shapes utilizing the improved carriage accomplishes the objects of the invention. As the carriages are moved along the closed circuit trackway, successive carriages are manipulated at sequential stations first to move the cores suspended thereon into registry with the molds carried thereby and to insert and lock the cores in the molds; then, after the slip is cast, to release the cores in balanced pairs and lift and laterally offset them from the molds; then, after dusting the cores and drying the castings to green cure them, the castings are withdrawn from the molds; and, finally, the molds and cores are further dried in preparation for another cycle.

What is claimed is:

1. A movable carriage for use in a slip casting system comprising, a frame, vertically spaced first and second supporting means on said frame, at least one of said supporting means movable vertically with respect to said second supporting means, at least one of said supporting means movable laterally with respect to the other said supporting means, a plurality of molds supported on one said supporting means and a plurality of cooperatively interfitting cores supported on the other of said supporting means in balanced pairs by connecting means, relative lateral movement between said supporting means vertically registering and laterally separating said cores and molds, and relative vertical movement between said supporting means when said cores and molds are in register selectively inserting said cores into and extracting said cores from said molds, said connecting means for the cores

in any pair being the same length but the lengths of the connecting means for said pairs being different so that vertical separation of said supporting means progressively releases the pairs of cores from their respective molds.

2. A movable carriage for use in a slip casting system comprising, a frame, a head bar and a table supported on said frame, means to effect relative lateral movement between said head bar and table, and separate means to effect relatively vertical movement between said head bar and table, a plurality of cores carried on said head bar in balanced pairs by connecting means and a plurality of cooperatively interfitting molds carried on said table, relative lateral movement between said head bar and the table vertically registering and laterally separating said cores and molds and relative vertical movement between said head bar and table when said cores and molds are in register selectively inserting said cores into and extracting said cores from said molds, said connecting means for the cores in any pair being the same length but the lengths of the connecting means for said pairs being different so that said cores are progressively extracted in pairs.

3. A carriage for use in a slip casting system comprising, a movable frame, a head bar supported above said frame and movable vertically toward and away from said frame, a table between said head bar and said frame, said table supported by and movable laterally of said frame, a plurality of cores dependently supported from said head bar in balanced pairs by connecting means, a corresponding plurality of molds supported on said table, lateral movement of said table moving said molds into and out of vertical registry with said cores, and vertical movement of said head bar when said cores and molds are in register selectively inserting said cores into and extracting said cores from said molds said connecting means for the cores in any pair being the same length but the lengths of the connecting means for said pairs being different so that said cores are progressively extracted in pairs.

4. A carriage for use in a slip casting system comprising, a frame, wheel means for moving said frame, a stanchion means extending vertically upwardly of said frame, a head bar supported by and vertically movable on said stanchion means, a plurality of cores dependently supported from said head bar in balanced pairs by connecting means, a laterally movable table carried on said frame, a plurality of molds secured on said table, lateral movement of said table moving said molds into and out of registry with said cores, and vertical movement of said head bar when said cores and molds are in register selectively inserting said cores into and extracting said cores from said molds said connecting means for the cores in any pair being the same length but the lengths of the connecting means for said pairs being different so that said cores are progressively extracted in pairs.

5. A carriage for use in a slip casting system comprising, a frame, wheel means on said frame for moving said carriage longitudinally of itself, a stanchion means extending vertically upwardly from each longitudinal end of said frame, a head bar extending longitudinally between said stanchion means and vertically slidable thereon to an up and down position, a plurality of mold cores, a yoke mount secured to the upper portion of each said mold core, connecting means linking each said yoke with said head bar by which said cores are dependently supported from said head bar, said connecting means being of different lengths so that raising said head bar progressively releases said cores from their molds, a table carried on said frame, a plurality of molds supported on said table, said table being movable laterally on said frame selectively to position said molds into and out of vertical alignment with their respective cores when said head bar is in up position, movement of said head bar to down position when said cores are aligned with said

molds effecting an insertion of said cores into said molds, and separate locking means to maintain said head bars selectively in up or down position.

6. A carriage for use in a slip casting system comprising, a frame, wheel means on said frame for moving said carriage longitudinally of itself, a stanchion means extending vertically upwardly from each longitudinal end of said frame, a head bar extending longitudinally between said stanchion means and vertically slidable thereon to an up and down position, a plurality of mold cores, a yoke mount secured to the upper portion of each said mold core, connecting means linking each said yoke with said head bar by which said cores are dependently supported from said head bar, a pressure beam between each said yoke and said head bar, adjustable spring means operatively interposed between said pressure beam and said yoke, said pressure beam being engaged by said head bar when said head bar is in down position to clamp said cores into said molds, a table carried on said frame, a plurality of molds supported on said table, said table being movable laterally on said frame selectively to position said molds into and out of vertical alignment with their respective cores when said head bar is in up position, movement of said head bar to down position when said cores are aligned with said molds effecting an insertion of said cores into said molds, and separate locking means to maintain said head bars selectively in up or down position.

7. A carriage for use in a slip casting system comprising, a frame, wheel means on said frame for moving said carriage longitudinally of itself, a stanchion means extending vertically upwardly from each longitudinal end of said frame, a head bar extending longitudinally between said stanchion means and vertically slidable thereon to an up and down position, a plurality of mold cores, a yoke mount secured to the upper portion of each said mold core, connecting means linking each said yoke with said head bar by which said cores are dependently supported from said head bar, said connecting means being of different lengths so that raising said head bar progressively releases said cores from their molds, a pressure beam between each said yoke and said head bar, adjustable spring means operatively interposed between said pressure beam and said yoke, said pressure beam being engaged by said head bar when said head bar is in down position to clamp said cores into said molds, a table carried on said frame, a plurality of molds supported on said table, said table being movable laterally on said frame selectively to position said molds into and out of vertical alignment with their respective cores when said head bar is in up position, movement of said head bar to down position when said cores are aligned with said molds effecting an insertion of said cores into said molds, and separate locking means to maintain said head bars selectively in up or down position.

8. A carriage for use in a slip casting system comprising a frame, wheel means on said frame for moving said carriage longitudinally of itself, a stanchion means extending vertically upwardly from each longitudinal end of said frame at a point located laterally inwardly from one longitudinal side approximately one-fourth of the lateral dimension thereof, a head bar extending longitudinally between said stanchion means and vertically slidable thereon to an up and down position, a plurality of cores dependently supported from said head bar in balanced pairs by connecting means, a table carried on said frame, the width of said table being approximately one-half the width of said frame, a plurality of molds supported on said table, said table being movable laterally on said frame selectively to position said molds into and out of vertical alignment with their respective cores when said head bar is in up position, movement of said head bar to down position when said cores are aligned with said molds effecting an insertion of said cores into said molds, said connecting means for the cores in any pair being the same

length but the lengths of the connecting means for said pairs being different so that said cores are progressively extracted in pairs when said head bar is moved to up position, and separate locking means to maintain said head bars selectively in up or down position.

9. A carriage for use in a slip casting system comprising, a rectangular frame, wheel means on said frame for moving said frame longitudinally, a stanchion means extending vertically upwardly from each end of said frame at a point located laterally inwardly from one longitudinal side approximately one quarter of the lateral dimension of said frame, a head bar extending longitudinally between and supportable by said stanchion means, bearing means for vertically sliding said head bar along said stanchion means to an up and down position, a plurality of mold cores dependently supported from said head bar in balanced pairs by connecting means, a table carried on said frame, a plurality of molds supported on said table, said table being movable laterally on said frame selectively to position said molds into and out of vertical alignment with their respective cores when said head bar is in up position, movement of said head bar to down position when said cores are aligned with said molds effecting an insertion of said cores into said molds, said connecting means for the cores in any pair being the same length but the lengths of the connecting means for said pairs being different so that said cores are progressively extracted in pairs when said head bar is moved to up position, and separate locking means to maintain said head bars selectively in up or down position.

10. A carriage for use in a slip casting system comprising, a rectangular frame having longitudinal and lateral sides, wheel means on said frame for moving said frame longitudinally, a stanchion means extending vertically upwardly from each end of said frame at a point located laterally inwardly from one longitudinal side approximately one quarter of the lateral dimension of said frame, a head bar extending longitudinally between and supportable by said stanchion means, bearing means for vertically sliding said head bar along said stanchion means to an up and down position, a plurality of mold cores dependently supported from said head bar, a table, said table having a width equal to approximately one-half the width of said frame, wheel means on said table, said wheel means engaging said frame for moving said table laterally with respect to said frame, a plurality of molds supported on said table such that the lateral movement of said table selectively positions said molds into and out of vertical alignment with their respective cores when said head bar is in up position, a yoke mount secured to the upper portion of each said mold core, connecting means linking each said yoke with said head bar by which said cores are dependently supported from said head bar, said connecting means being of different lengths so that raising said head bar progressively releases said cores from their molds, a pressure beam between each said yoke and said head bar, adjustable spring means operatively interposed between said pressure beam and said yoke, said pressure beam being engaged by said head bar when said head bar is in down position to clamp said cores into said molds.

11. A movable carriage for use in a slip casting system comprising, a frame, a head bar and table supported on said frame, means to effect relative lateral movement between said head bar and table and separate means to effect relatively vertical movement between said head bar and said table, a plurality of mold cores, a yoke mount secured to the upper portion of each said core, connecting means linking each said core with said head bar by which said cores are dependently supported from said head bar, said connecting means being of such lengths that said cores are spaced beneath said head bar at different distances, relative lateral movement between said head bar and said table vertically registering and laterally separating said cores and molds, and relatively vertical movement between said head bar and tables when said cores are in registry

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selectively inserting said cores into and progressively extracting said cores from said molds.

12. A movable carriage for use in a slip casting system comprising, a frame, a head bar and a table supported on said frame, means to effect relative lateral movement between said head bar and table and separate means to effect relatively vertical movement between said head bar and said table, a plurality of mold cores, a yoke mount secured to the upper portion of each said core, connecting means linking each said core with said head bar by which said cores are dependently supported from said head bar, said connecting means being of such lengths that said cores are spaced beneath said head bar at different distances, a pressure beam between each said yoke and said head bar, adjustable spring means operatively interposed between said pressure beam and said yoke, relative lateral movement between said head bar and said table vertically registering and laterally separating said cores and molds, and relatively vertical movement between said head bar and tables when said cores are in registry selectively inserting said cores into and extracting said cores from said molds, said pressure beam being engaged by said head bar when said cores are inserted into said molds to clamp each said core into its respective mold under equal pressure.

13. A movable carriage for use in a slip casting system comprising, a frame, a head bar and table supported longitudinally on said frame, means to effect relative lateral movement between said head bar and table and separate means to effect relatively vertical movement between said head bar and said table, a plurality of mold cores, a yoke mount secured to the upper portion of each said core, connecting means linking each said core with said head bar by which said cores are dependently supported from said head bar in balanced longitudinal pairs, said connecting means being of such lengths that each pair of said cores are spaced beneath said head bar at different distances, a pressure beam between each said yoke and said head bar, adjustable spring means operatively interposed between said pressure beam and said yoke, relative lateral movement between said head bar and said table vertically registering and laterally separating said cores and molds, and relatively vertical movement between said head bar and tables when said cores are in registry selectively inserting said cores into and extracting said cores from said molds, said pressure beam being engaged by said head bar when said cores are inserted into said molds to clamp each said core into its respective mold under equal pressure.

14. A movable carriage for use in a slip casting system comprising, a frame, vertically spaced first and second supporting means on said frame, at least one of said supporting means movable vertically with respect to the other

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supporting means, at least one of said supporting means movable laterally with respect to the other said supporting means, a plurality of molds supported on the lower of said vertically spaced supporting means, a plurality of mold cores, a yoke mount secured to each mold core, connecting means linking each said yoke with the upper of said vertically spaced supporting means by which said cores are dependently supported from said upper supporting means, relative lateral movement between said supporting means vertically registering and laterally separating said cores and molds, relative vertical movement between said supporting means when said cores and molds are in register selectively inserting said cores into and extracting said cores from said molds, a pressure beam between each yoke and said upper supporting means, adjustable spring means operatively interposed between said pressure beam and said yoke, said pressure beam being engaged by said upper supporting means when said first and second supporting means have been moved vertically toward each other to clamp said cores into said molds.

15. A movable carriage for use in a slip casting system comprising, a frame, freely upstanding stanchion means at each longitudinal end of said frame, a first supporting means extending between and supported on said stanchion means, a second supporting means spaced vertically below said first supporting means and supported on said frame, a plurality of molds carried on said second supporting means and a plurality of cooperatively interfitting cores carried on said first supporting means in balanced pairs by connecting means, said first and second supporting means being relatively vertically movable selectively to insert said cores into and extract said cores from said molds, the connecting means for the cores in any pair being the same length but the lengths of the connecting means for said pairs being different so that said cores are progressively extracted in pairs when said head bar is moved to up position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,189,971

June 22, 1965

Fred L. Derror

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 1, line 64, for "transverse" read -- traverse --; column 3, line 38, for "moveemnt" read -- movement --; line 52, for "23" read -- 24 --; line 62, for "loose" read -- lose --; line 67, for "casting" read -- castings --; line 69, for "cam" read -- can --; column 4, line 45, for "flanges" read -- flange --; column 5, line 68, for "14d" read -- 13d --; column 10, line 62, and column 11, line 27, for "and table", each occurrence, read -- and a table --.

Signed and sealed this 18th day of January 1966.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents