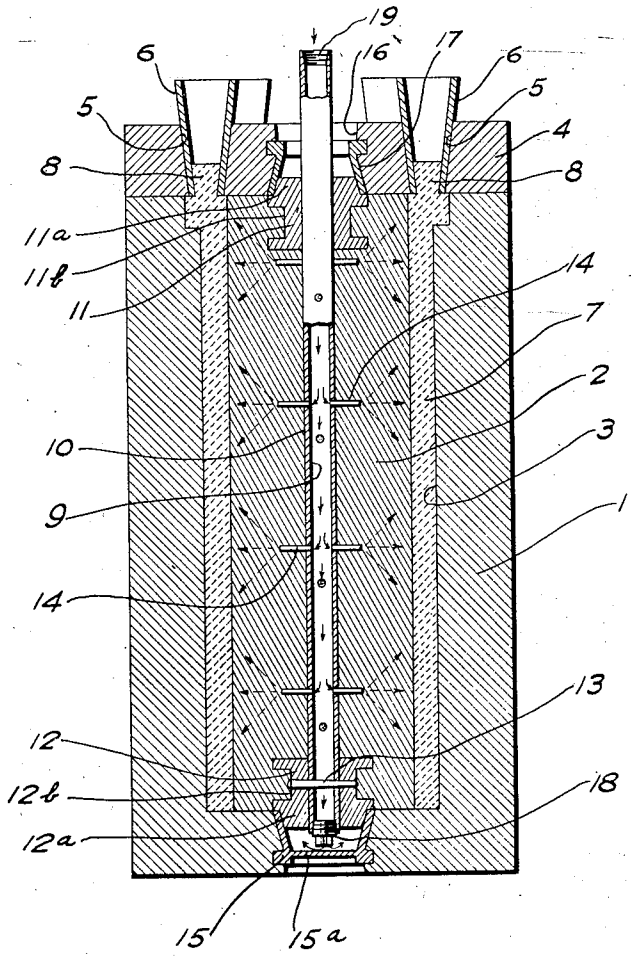
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APPARATUS FOR MAKING SLIP CASTINGS

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APPARATUS FOR MAKING SLIP CASTINGS

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This invention relates to the manufacture of slip castings and more particularly to the production by a slip cast process of refractory tubes, feeder spouts and other refractory articles that are suitable for use in contact with molten glass in a glass feeder or for similar service.

In producing a refractory article of the character described by the slip cast process, it is usual to pour a suitably prepared slip made of suitable materials into a suitable space surrounding a plaster core in a plaster mold. After the plaster core and mold have absorbed liquid from the slip and the residual casting has dried in the mold for a sufficient time, the core must be removed from such casting. However, the close contact of the casting with the core makes this difficult of satisfactory accomplishment. In actual practice, the core may be broken and/or the casting damaged by the operations required to separate and remove the core from the tube casting.

An object of the present invention is to obviate the difficulties previously encountered, as above described, in separating and removing a plaster core from a refractory slip casting surrounding that core in a plaster mold. The present invention attains the above and other objects by providing and making use of a novel combination of structural elements comprising a relatively simple and conveniently usable mold unit having means for producing a refractory slip casting therein and for separating and displacing the core from the casting without likelihood of breaking the core or the mold or damaging the casting.

A further object of the invention is to provide a novel method of effecting release of the slip casting surrounding the plaster core in the mold from such core when the casting has dried to the extent desired. The present invention also provides a novel method of displacing the core from the casting.

Other objects and advantages of the present invention hereinafter will be described or will become apparent from the following description of a practical embodiment of the invention and of its use in the production of a refractory tube casting. Such a practical embodiment of the invention is illustrated in the accompanying drawing by way of example and not of limitation. In the drawing:

The view is a vertical section through a mold unit provided according to the present invention, a portion of a central pressure fluid supply pipe of the core of the unit being shown in elevation.

In the drawing, a mold made of a suitable material that will absorb moisture, such as plaster of Paris, is designated 1. A core 2 may be made of a similar material and is of suitable size and configuration to be disposed centrally within the mold 1 so that a space 3 of suitable size and shape for the casting to be made remains between the core and the mold. In the example shown, the casting to be formed is to be cylindrical with an external flange or externally enlarged upper end portion and the space 3 hence is appropriately formed to define a casting of that description.

The core 2 rests at its bottom on the bottom of the mold 1 so that the space 3 is closed at its lower end by a portion of the bottom of the mold 1. The mold unit includes a mold top 4 which may be made of the same material as the core 2 and the mold 1 and is of suitable external size and configuration to be substantially aligned peripherally with the mold 1 when the mold top is properly located upon the upper end of such mold. The mold top 4 may be provided with vertical apertures 5 for the reception of removable metallic funnels 6 which will then be suitably located to dispose the open lower ends of these funnels over the annular space 3 at a plurality of places which are spaced angularly around the axis of the mold.

A suitably prepared slip of suitable materials may be poured through the funnels 6 into the space 3 until the entire annular space 3 is filled and additional slip is provided in the funnels to feed material to the underneath casting body as it dries and shrinks and loses liquid to the absorbent plaster core and plaster mold. After the slip casting, indicated at 7 in the drawing, has partially set and dried, the core of the mold unit must be removed. At this time, excess slip may remain in the funnels, as at 8. Features of the invention which obviate difficulties previously encountered in removing such a core will now be pointed out with reference to the particular structure shown in the drawing.

The core 2, instead of being solid throughout a transverse section thereof, is provided with an axial pressure fluid conducting passage 9, shown as the bore of a metallic tube 10 about which the body of the core 2 has been molded or otherwise formed. The metallic tube 10 is provided at the opposite end portions of the core with encircling annular metallic heads 11 and 12, respectively, each of which is partially embedded in that end portion of the core so that a portion thereof, designated 11*a* for the head 11 and 12*a*

for the head 12 projects beyond the adjacent end of the core. As shown, the heads 11 and 12 have identical projecting end portions 11a and 12a, each being circular in cross-sectional configuration and tapering slightly toward its outer end.

Each of the heads 11 and 12 is shown as having an annular groove or channel 11b or 12b in its periphery into which the material of the core extends so that the head is secured firmly in place in its end portion of the core. The head 12 also is shown as being secured to the tube 10 by a cross pin 13 and a similar pin may be employed to fasten the head 11 to the tube 10 if desired, or such pins may be dispensed with if not required.

The tube 10 is provided at a plurality of places which are spaced apart longitudinally and circumferentially thereof with lateral outlets. In the example shown, these lateral outlets comprise open passages in short lateral tubes or branches 14 which communicate at their inner ends with the interior of the tube 10 and terminate at their outer ends in the body of the core 2 at a suitable radial distance from the external surface of the core 2. In the example shown, the distance from the outer end of each lateral tube 14 to the outer surface of the core is slightly more than the length of the lateral tube but this ratio may be varied to a substantial extent in either direction.

The bottom of the mold 1 has its central portion apertured for the reception of a suitably shaped socket member 15, which may be formed of metal and which is embedded in the bottom wall of the mold 1 so that the open upper end of the socket 15 is substantially flush with the upper surface of the bottom wall of the mold and is adapted to receive the projecting end portion 12a of the head 12 when the core 2 is lowered into the mold 1 centrally of the latter. The projecting portion 12a of the head 12 has a close telescopic fit with the upper portion of the downwardly tapering socket member 15 when the core is lowered to the bottom of the mold 1, leaving a space at 15 between the inserted end portion of the head 12 and the bottom wall 15a of the socket 15. The telescopic sliding engagement of the projecting portion 12a of the head 12 at the lower end of the core 2 with the downwardly sloping annular side wall of the socket 15 serves to center the core 2 in the mold 1 when the core is lowered to position in such mold. These parts also may perform a further function according to the present invention, as presently will be pointed out.

The mold top 4 also may be centrally apertured, as at 16, to afford clearance for the upwardly projecting portion of the tube 10. A metallic open ended socket member 17 having an upwardly tapering annular body portion substantially like that of the socket member 15 may be provided in the apertured central portion of the mold top 4 to telescopically fit and engage with the upwardly projecting end portion 11a of the head member 11 at the top of the core so as to center the mold top 4 on the mold as such top member is lowered to place on such mold.

A suitable reduction nipple or nozzle 18 may be provided at the lower end of the tube 10 within the socket 15. The upper end of the tube 10 may be adapted, as by the internal screw threads indicated at 19, for connection with any suitable source of compressed air or fluid under pressure.

In producing a slip cast refractory tube according to the present invention by the use of the structure described, operations may be performed substantially as follows.

At a suitable time, the funnels 6 may be removed, the mold top 4 removed from the mold and any surplus material at the top of the casting removed and the top surface of the casting 7 smoothed off. The next step is to effect release of the core from the tube casting and to remove such core. In accomplishing this, air under pressure may be supplied to the tube 10. This air will pass outwardly through the lateral outlets from the tube 10 and through the pores of the plaster core to the casting 7. Moisture will be forced from the pores of the plaster core ahead of the air and will form a thin film of liquid and/or air between the core and the casting 7 as the latter is forced outwardly from the core by the pressure fluid. This film will aid in effecting clean separation of these parts and will lubricate them so that the core may be readily withdrawn from the casting without requiring the usual hammer blows to drive it from place and without damage to the core or casting.

Air under pressure also may be discharged into the space in the socket 15 to cause the latter to function as a power cylinder. The pressure of the air therein will act on the head 12 as on a piston and will force such head and the core upward and thus aid removal or withdrawal of the core from the casting. The pressure on the air may be selected to meet the requirements of each particular operation. Air under a pressure of approximately 15 lbs. and applied but for a brief period has been satisfactorily employed in practice.

If desired, the mold unit may be inverted during the step of removing the core from the casting for convenience of operation or for any other useful purpose. It of course will be understood that the shrinkage of the casting will be away from the side wall of the outer mold 1 so that ordinarily there is no difficulty in removing a slip casting from such a mold.

By the use of the present invention, the same core may be used repeatedly in the production of successive similar castings. The casting will be undamaged by the removal of the core and hence may be made of slips which in turn are made of the materials best adapted for the production of refractory tubes most suitable for the service intended. Moreover, the operation of producing the tube casting may be carried on without the necessity of accepting less than the most suitable time periods involved and consequently the slip casting may be dried adequately on the core for the most desirable results in the manufacture of the final tube.

The invention is not restricted to the particular structure shown and described or to use for the production of this type of casting alone but may embody suitable apparatus for producing slip castings of various configurations and intended for various uses.

I claim:

1. Apparatus for making slip cast refractory tubes comprising an upright substantially cylindrical mold open at its upper end, a substantially cylindrical core disposed within said mold in spaced concentric relation therewith so as to leave an annular space between the core and the inner side wall of the mold, a metallic tube extending axially through the core, said tube being open at its upper end for the entry of air under pressure thereinto and having an outlet at its

lower end for discharge of air under pressure therefrom, an open-topped socket member at the bottom of the mold beneath the lower end of said core and in position to receive air under pressure from said metallic tube, said socket member being closed at its bottom, and an annular head surrounding the lower end of the metallic tube and having a portion projecting beneath the bottom of the core for engaging slidably with said open-topped socket member at the bottom of the mold to aid in centering the core in the mold and to serve as a piston for moving the core upward under the pressure of air supplied through said metallic tube to the underlying space in said open-topped socket member.

2. Apparatus for making slip cast refractory tubes comprising an upright open-topped substantially cylindrical mold, a substantially cylindrical core disposed within the mold in spaced concentric relation therewith so as to leave an annular space between the core and the inner side wall of the mold for the reception of a slip to form a tube casting, said core being made of a material that will absorb moisture from the slip, and a pneumatic device for impelling the core upwardly relatively to the tube casting, said pneumatic device comprising an open-topped socket member in the bottom portion of the mold beneath the core, said socket member being closed at its bottom, a piston carried by the core at its bottom for entering and forming a substantially air-tight sliding contact with the internal side walls of said socket member, and means for supplying air under pressure to said socket member.

3. Apparatus for making slip casting refractory tubes comprising an upright open-topped substantially cylindrical mold, a substantially cylindrical core disposed within the mold in spaced concentric relation therewith so as to leave an annular space between the core and the inner side wall of the mold for the reception of a slip to form a tube casting, said core being made of a material that will absorb moisture from the slip, and a pneumatic device for impelling the core upwardly relatively to the tube casting, said pneumatic device comprising an open-topped socket member in the bottom portion of the mold beneath the core, said socket member being closed at its bottom, a piston carried by the core at its bottom for entering and forming a substantially air-tight sliding contact with the internal side walls of said socket member, and means for supplying air under pressure to said socket member and for forcing air under pressure outwardly from an axial portion of the core through the pores thereof against said tube casting.

4. Apparatus for making refractory slip castings comprising an upright hollow mold open at its top and having a bottom, a substantially cylindrical core movable axially through the open upper end of said hollow mold to and from position to rest at its lower end upon the bottom of said hollow mold, the diameter of said core being substantially less than the inner diameter of said hollow mold, cooperative core centering members respectively carried by the lower end portion of the core and the bottom of the hollow mold and having tapering portions telescopically engaging each other to guide the lower end of the core to a centered position within said hollow mold when the core is lowered axially in the mold to the bottom thereof in approximately concentric relation with said mold, leaving an annular space between said core and the inner side wall of the mold, a mold top fitting upon said hollow mold and an open funnel extending vertically through a portion of the mold top in position to discharge the materials of a suitably prepared slip downwardly into the annular space within the mold around the core therein when said mold top is in operative position upon the mold.

5. Apparatus for making refractory slip castings comprising an upright hollow mold open at its top and having a bottom, a substantially cylindrical core movable axially through the open upper end of said hollow mold to and from position to rest at its lower end upon the bottom of said hollow mold, the diameter of said core being substantially less than the inner diameter of said hollow mold, cooperative core centering members respectively carried by the lower end portion of the core and the bottom of the hollow mold and having tapering portions telescopically engaging each other to guide the lower end of the core to a centered position within said hollow mold when the core is lowered axially in the mold to the bottom thereof in approximately concentric relation with said mold, leaving an annular space between said core and the inner side wall of the mold, a mold top fitting upon said hollow mold and cooperative core centering members respectively carried by the upper end portion of the core within the mold and by said mold top and having tapering portions telescopically engaging each other to guide the upper end portion of the core to a centered position within the mold when the mold top is placed in its said operative position upon the mold.

6. Apparatus for making refractory slip castings of tubular form comprising an upright hollow mold open at its top and having a bottom, a substantially cylindrical core resting at its lower end upon the bottom of said hollow mold in approximately concentric relation with said mold, said core having a diameter substantially less than the inner diameter of said hollow mold to provide an annular space between said core and the inner side wall of the mold for the reception of a suitably prepared slip of refractory casting materials, said core being made of a material that will absorb moisture from the slip, and a vertical tubular air conducting member fitting within said core centrally thereof for the full length of the latter, said tube being formed at its upper end for connection with a source of air under pressure and being provided at numerous places throughout the length of the portion thereof that is located within said core with lateral outlets for the discharge of air from the interior of the tube outwardly through the material composing the core toward the space between said core and the inner wall of said hollow mold, certain of said lateral outlets being located diametrically opposite other of said lateral outlets so as to provide a plurality of pairs of diametrically opposite lateral outlets for said tube at a plurality of places along the length of the portion of said tube within said core.

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