Nov. 17, 1964 L. F. MILLER ETAL 3,156,958

FOUNDRY MOLDING MACHINE

Filed July 9, 1962 2 Sheets-Sheet 1

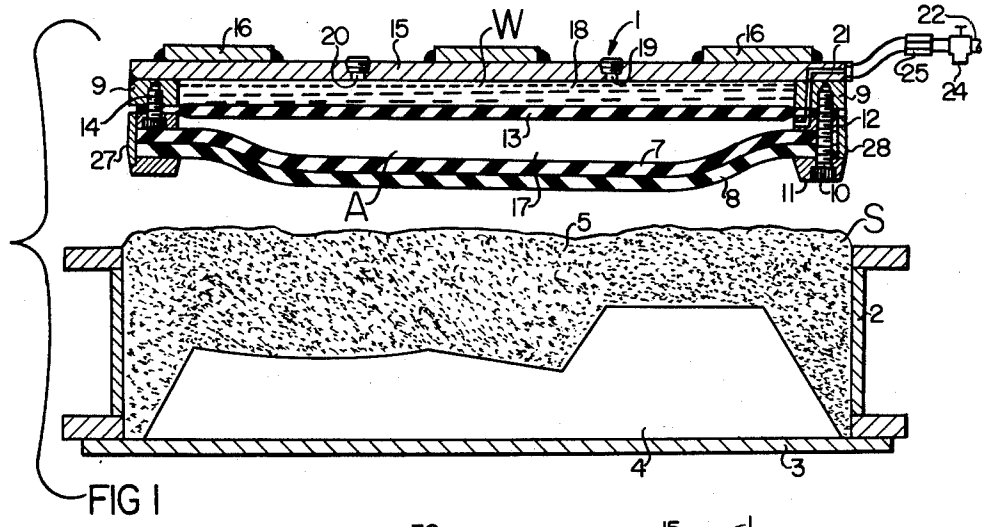


FIG 1

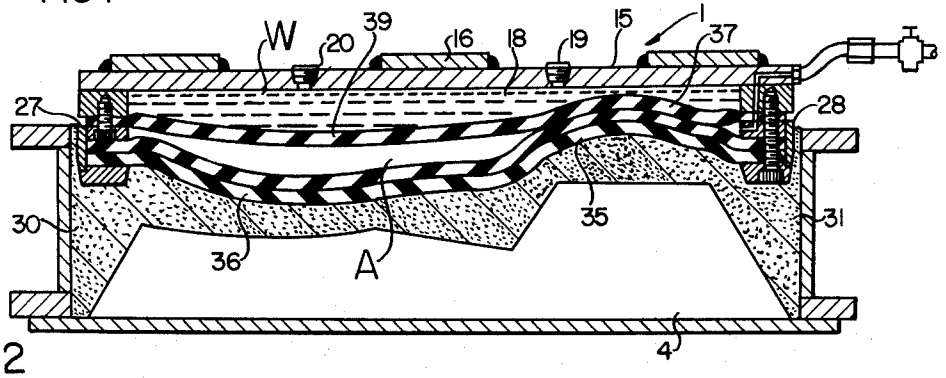


FIG 2

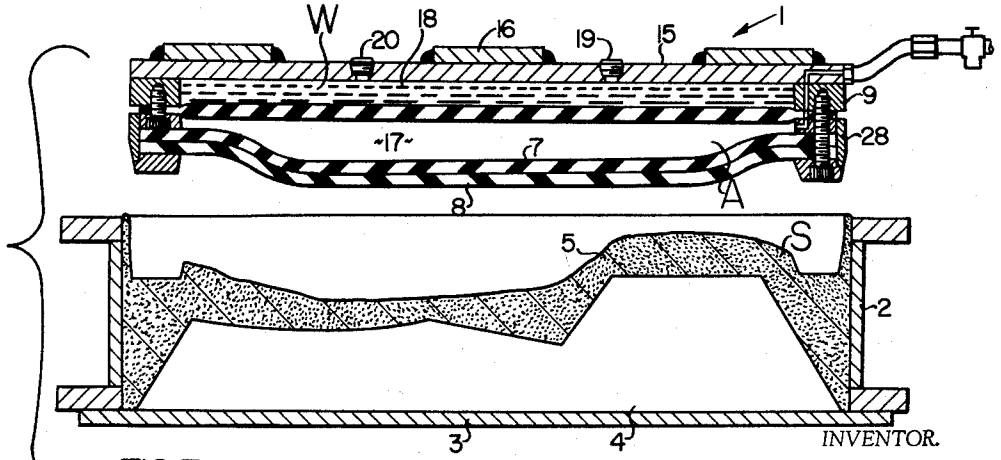


FIG 3

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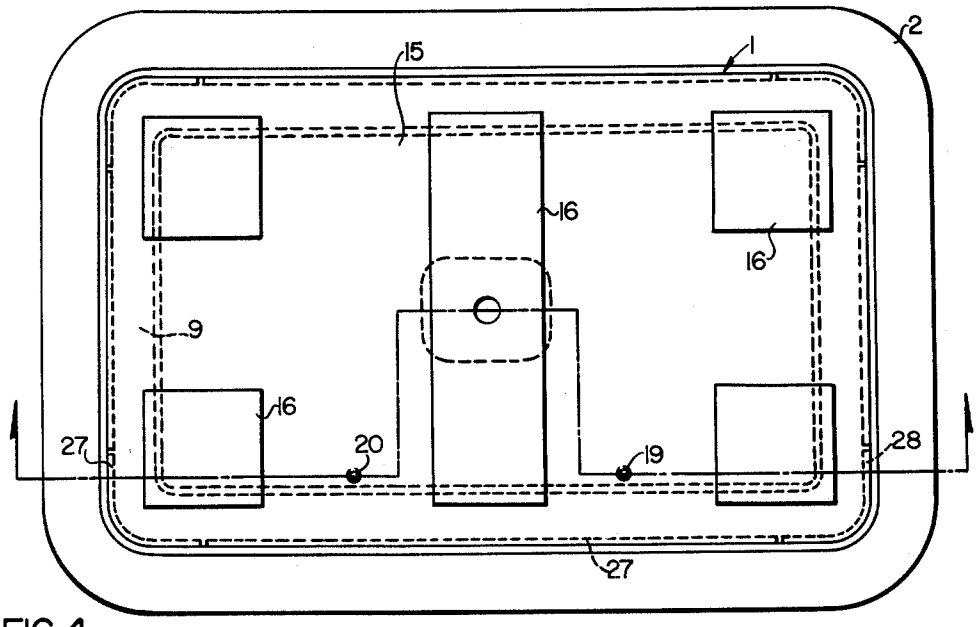


FIG 4

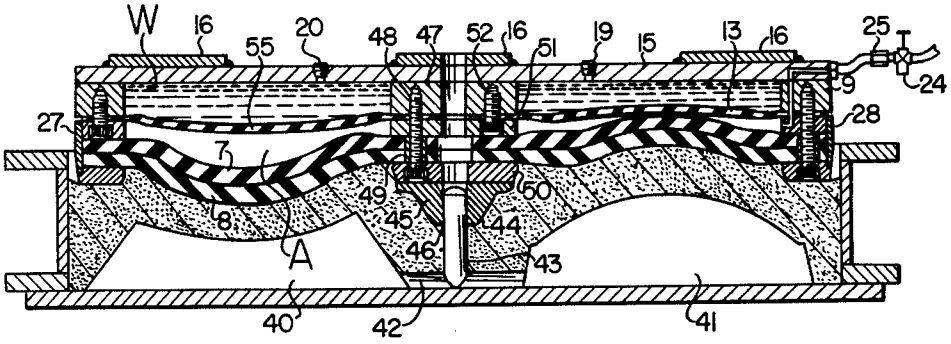


FIG 5

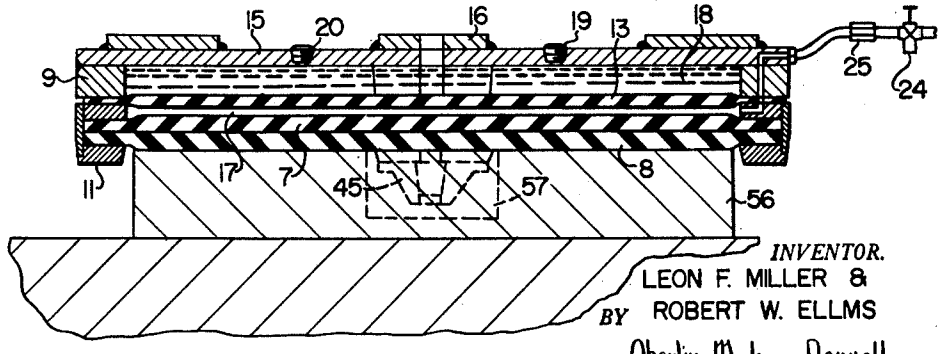


FIG 6

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FOUNDRY MOLDING MACHINE

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14 Claims. (Cl. 22—42)

This invention relates generally, as indicated, to a foundry molding machine and more particularly to certain improvements in a squeeze head for a foundry molding machine adapted to produce rapidly foundry molds of uniform desired hardness.

In the copending application of Edmond K. Hatch and Leon F. Miller, Serial No. 127,616, entitled "Squeeze Molding Machine," filed July 28, 1961, there is disclosed a foundry molding machine having a diaphragm squeeze head which has been found to be particularly suitable for exerting uniform squeezing pressure on said molds in high speed automatic sand molding operations and which has proven quite durable in spite of the frequency of use and high pressures involved.

With diaphragm foundry molding machine squeeze heads, it is difficult to maintain a uniform high degree of pressure over the entire upper surface of a sand mold especially when the amount of sand within such mold may vary from one cycle of operation of the machine to the next. If the diaphragm over a high point of the pattern should contact a solid inflexible back-up as the result of insufficient sand being within the mold, considerable damage may result to the pattern and, of course, an improper mold will be formed. Moreover, the pressure exerted by the diaphragm upon the sand will not then be distributed uniformly over the entire top of the sand mold.

It is accordingly a principal object of the present invention to provide a squeeze head for a foundry molding machine which will exert a uniform high degree of pressure on the sand mold regardless of variations in the amount of sand employed.

A further principal object is the provision of a squeeze head for a foundry molding machine having a flexible sand engaging surface provided with a laterally displaceable yet incompressible safety back-up.

Yet another principal object is the provision of a squeeze head for a foundry molding machine utilizing both a compressible and incompressible fluid.

A yet further object is the provision of a diaphragm squeeze head for a foundry molding machine employing a relatively small volume of compressible fluid and a separate back-up body of displaceable yet incompressible fluid.

Yet another object is the provision of a squeeze head for foundry molding machine which will exert a uniform high degree of pressure on the order of in excess of 200 pounds per square inch on the surfaces of relatively large sand molds.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a vertical section of a squeeze head in accordance with the present invention shown above a sand filled flask prior to the compaction of sand therein;

FIG. 2 is a vertical section similar to FIG. 1 showing the relative position of the squeeze head and flask during the final stages of the squeezing operation;

FIG. 3 is a similar vertical section showing the squeeze head and flask separated after the squeezing operation;

FIG. 4 is a top plan view of another form of squeeze head in accordance with the present invention;

FIG. 5 is a vertical section of such squeeze head shown in sand squeezing position taken substantially on the line 5—5 of FIG. 4; and

FIG. 6 is a vertical section illustrating the manner in which the various chambers of the squeeze head are filled with the respective fluids.

Referring now to the annexed drawings and more particularly to the embodiment of the invention shown in FIGS. 1 through 3, it will be seen that the squeeze head shown generally at 1 is employed with conventional foundry sand molding apparatus such as the flask 2, pattern plate 3, and pattern 4 supported on such pattern plate within the confines of the flask. In conventional foundry practice, the flask 2 is filled with a molding sand S and the squeeze head and flask are then positioned in approximately the relative positions shown in FIG. 1 either by laterally moving the flask after thus filled with sand to a position beneath the squeeze head 1 or by shifting the squeeze head over the sand filled flask. When the squeeze head and sand filled flask are thus vertically aligned as shown, they are moved relatively to each other to cause the squeeze head to engage the upper surface 5 of the sand within the flask to compress such sand against the pattern 4. When the sand has been compressed to the desired pressure by such relative movement as seen in FIG. 2, the head and flask will be moved apart to the FIG. 3 position and the flask containing the now compressed sand will generally be shuttled from the machine to have the pattern drawn therefrom. The squeeze head of the present invention may be employed, for example, with a machine of the type set forth in the disclosure of the aforementioned Hatch et al. application, Serial No. 127,616 entitled "Squeeze Molding Machine" wherein the pattern plate 3 is positioned on a vertically movable table adapted to elevate the pattern and flask filled with sand against a relatively fixed squeeze head. The squeeze cylinders supporting the table and, of course, the pattern plate then provide the squeeze pressure. It will also be understood that the squeeze head may be mounted for vertical movement by overhead squeeze cylinders such as those shown in the copending application of Edmond K. Hatch and Leon F. Miller, Serial No. 133,700, entitled "Overhead Squeeze Molding Machine," filed August 24, 1961. In machines of this type, the flask containing the sand will be generally fixed relative to the vertically movable head supported by overhead squeeze piston-cylinder assemblies. In any event, relative vertical movement of the flask and head, usually by high pressure hydraulic piston-cylinder assemblies, is all that is required for the squeeze head to exert the desired pressure upon the sand within the flask, squeezing the same to provide a sand mold of the desired uniform hardness. The flask, pattern plate, and pattern, of course, form no part of the present invention.

The squeeze head 1 comprises a downwardly opening cavity forming a chamber having a lower or bottom flexible sand engaging wall in the form of two juxtaposed relatively thick diaphragm members 7 and 8. These diaphragm members extend across the bottom of the chamber or cavity and are held to the peripheral side walls 9 of such chamber by elongated screws or the like 10 passing through a peripheral clamping ring 11. Such fasteners 10 also pass through a further clamping ring 12 holding an intermediate diaphragm 13 extending horizontally across the chamber. The diaphragms 7 and 8

in their unsupported position will bulge downwardly as indicated below the plane of their peripheral edges secured to the cavity. The clamping ring **12** may be held to the sides **9** of the chamber or cavity by similar fasteners indicated at **14**. The top wall of the chamber is formed by the plate **15** which may be welded or otherwise suitably secured to the peripheral downwardly projecting sides **9**. Back-up plates **16** may be secured to the top of the top plate **15** to rigidify the same and to facilitate the attachment of the head to the head of a foundry molding machine frame or the like.

The intermediate diaphragm **13** held by the clamping plate **12** then serves to compartment the chamber in the squeeze head formed by the side walls **9**, the top plate **15** and the bottom flexible sand-engaging wall **7**, **8**. In this manner, the squeeze head is provided with two sealed chambers **17** and **18** being horizontally separated by the intermediate diaphragm **13**.

Into the compartment **18**, there is provided a substantially incompressible fluid such as water W and such water may be placed in such compartment by means of a fill aperture **19** and a vent aperture **20**, both being illustrated as plugged. The fluid in compartment **18** preferably completely fills such compartment and, in effect, constitutes a water back-up for the compartment **17** and the lower relatively thick diaphragms **7** and **8**. A passageway **21** leading through the clamping ring **12**, the side walls **9** and the top plate **15** extends to air inlet **22** through pressure regulator **24** and check valve **25**. Through such inlets, a compressible fluid such as air A may be supplied to the compartment **17**.

It is noted that the peripheral exterior dimension of the squeeze head is somewhat smaller than the peripheral interior dimension of the flask **2**. As seen in FIG. 2, this relative dimensioning of the flask and squeeze head permits the squeeze head to telescope within the flask as the squeeze head and flask are moved relative to each other. To avoid wear on the exposed peripheral edges of the diaphragms **7** and **8**, peripheral side plates are provided shown at **27** and **28**. These side plates also serve properly to rigidify the peripheral structure formed by the clamping ring **11** which, of course, serves as an annular squeeze biscuit adapted to engage the sand near the outer periphery of the flask to provide a rigid firm squeeze where the sand is deepest as indicated at **30** and **31** in FIG. 2, since the pattern **4** does not generally extend too closely to the flask walls. The sides of the clamping ring **11** as well as the outer surface of the plates **27** and **28** are beveled as shown to facilitate sand penetration. The outer side walls of the clamping ring **11** are similarly so beveled and also the inner side walls of such ring. Thus without reducing the clamping area of such ring, greater sand penetration is obtainable.

It can now been seen that there is provided in the FIGS. 1 through 3 embodiment, a foundry molding machine head comprising essentially a horizontally diaphragm compartmented chamber having a flexible sand engaging wall provided by the lower diaphragms **7** and **8** with fluids of different compressibility being segregated by the compartmenting diaphragm **13** and sealed in such compartments.

As seen in FIGS. 2 and 3, when the head and flask are moved relatively to each other, the head will telescope within the flask squeezing the sand against the pattern **4**. As the squeeze pressure increases, the flexible sand engaging wall of the squeeze head chamber formed by the diaphragms **7** and **8** will flex and conform to the upper surface of the sand mold being produced. As the squeeze pressure increases, the air trapped in the chamber **17** by the check valve **25** increases in pressure and, of course, reduces in volume. As the volume decreases, the pressure exerted by the air in the chamber **19** on the diaphragms **7** and **8** and, of course, on the sand S will increase. In fact, pressures in excess of 200 pounds per square inch are obtainable, and for medium size squeeze heads, this may mean a total pressure in excess of 100 tons. Since, of course, the air is laterally displaceable, the pressure over the entire upper surface of the diaphragm will always be the same at any spot thereon. Thus even though the diaphragm may bulge upwardly as indicated at **35**, the pressure exerted by that portion of the diaphragm will be the same as that where it may bulge downwardly as indicated at **36**. It is noted that the irregularities in the surface of the diaphragms tend to conform to the irregularities in the surface of the pattern **4** and at high points of the pattern. The diaphragm will bulge upwardly and conversely, at lower points the diaphragm will generally bulge downwardly maintaining a somewhat uniform sand depth over the entire upper surface of the pattern. Since the air is quite compressible, it is desirable to have a relatively small volume of air in the final compression stages of the operation as indicated in FIG. 2. However, it is not desirable to have the sand engaging diaphragm touch a solid backing at the high points of the pattern as indicated by the upward bulge **35**, since no further lateral displacement of the air would obtain at that spot. Accordingly, uniform pressures will not be then exerted over the entire upper surface of the sand mold. The water in chamber **18** segregated from the air in chamber **17** by the diaphragm **13** then serves to provide a backing for the squeeze head composed of an incompressible yet displaceable substance. When the diaphragms **7** and **8** bulge upwardly as indicated at **35** and the upper diaphragm **7** engages the segregating diaphragm **13** as indicated at **37**, the fluid within chamber **18** will displace laterally causing the diaphragm **13** to bulge downwardly as indicated at **39** as the liquid is thus laterally displaced. Such displacement of the liquid will, however, not affect the uniformity of the pressure per area force exerted by the squeeze head. Nor will such displacement affect the volume of compartment **17** and thus the pressure exerted by the air A. Only the movement of the sand against the diaphragms **7** and **8** will reduce the volume of compartment **17**. The liquid upper portion of the squeeze head is accordingly a safeguard obtaining both a small volume of air for the squeezing operation and a safety back-up for the squeeze diaphragm precluding pattern damage and non-uniformity of hardness in the sand mold.

When the squeeze head and flask are moved relatively apart as seen in FIG. 3, the diaphragms **7** and **8** will reassume the position shown in FIG. 1 and the pressure within the chamber **17** will drop back to its original low level. The pattern will then be drawn, the sand mold removed, and a new flask placed in position and filled with sand.

In FIGS. 4, 5 and 6, there is illustrated another embodiment of the present invention wherein the squeeze head **1** is provided with a central support for the formation of a sprue opening and pouring basin in the sand mold. As seen more particularly in FIG. 5, the pattern comprises two main sections **40** and **41** interconnected by a dowel or like member forming the interconnecting passageway **42** and having a sprue pin or dowel extending vertically therefrom as indicated at **43**. The members **42** and **43** form the gating system for the pattern, which, it will be understood, will be the passageways or sprue openings for the introduction of molten metal into the pattern formed cavities in the sand mold. A pouring basin indicated at **44** will be formed in the finished sand mold adjacent the top of the vertically extending sprue opening provided by the sprue dowel **43**. To form this pouring basin, the squeeze head is provided with a centrally located depending conoidal projection **45** having a centrally located vertically extending aperture **46** adapted to mate with the vertically projecting sprue dowel **43**. The pouring basin forming member **45** is supported on the block **47** by elongated screws or the like **48**. The block **47** is in turn welded directly to the underside of the top plate **15** of the squeeze head **1**. Collars or the like **49** sur-

rounding the screws 48 will serve rigidly to support the member 45 with respect to the plate 15 and thus the head 1. The member 45 also serves as a center support for the diaphragms 7 and 8 which are compressed between the flange portion 50 of the member 45 and spacer 51 separating such diaphragms from the diaphragms 13. In this embodiment, the diaphragms 7, 8 and 13 are provided with central apertures aligned with central apertures in the blocks 47, 51 and the pouring basin forming member 45. Also, apertures may be provided in the plates 15 and the support 16 as indicated also aligned with the sprue dowel 43 to vent the aperture 46 as the squeeze head is brought into compression engagement with the mold box. Fasteners in the forms of screws 52 may be employed to hold the spacer 51 properly in position against the block 47 compressing the diaphragm thereagainst in sealed relation. Aside from the central support for the formation of the sprue and pouring basin, the squeeze head is otherwise identical in form to the squeeze head shown in the embodiment of the invention in FIGS. 1 through 3. The diaphragms 7, 8 and 13 are, however, both peripherally and centrally clamped to the squeeze head to provide, in effect, an annular flexible sand engaging wall, and similarly during the squeezing operation as shown in FIG. 5, as the diaphragms 7 and 8 bulge upwardly due to the higher pattern portion 41, such diaphragms may engage the diaphragm 13 causing it also to bulge upwardly laterally to displace the water W causing the diaphragm 13 to bulge downwardly as indicated at 55 over the lower pattern portion 40.

Referring now to FIG. 6, to set up the squeeze head, it may be placed on a flat block 56 having a center cut-out portion 57 accommodating the pouring basin forming projection 45. The block is dimensionally smaller than the interior of the clamping ring 11 so that the head will be supported entirely upon the bottom diaphragm 8. Initially, the vent 20 may be unplugged, and the top chamber 18 may then be filled with water through the water inlet 19. When water has reached the vent level and runs over, the water may be shut off and both the vent and inlet passages may then be plugged. The squeeze head may then be removed from the flat block 56 and air pressure will be inserted into the lower into the lower relatively smaller chamber through the pressure regulator 24. Such regulator maintains a continuous low minimum of pressure within the chamber 17 and the diaphragms 7 and 8 are caused to bulge downwardly as indicated, for example, in FIGS. 1 and 3. This low pressure is maintained at all times and during the squeeze operation, the check valve 25 traps air in the chamber 17 which thereby develops extremely high pressures as the squeeze stroke progresses.

Although the upper diaphragm 13 may seldom be bulged or distorted as indicated in FIGS. 2 and 5, it does provide an added safety feature in that should the flask be filled with insufficient sand, the patterns will not be damaged as the result of the diaphragms 7 and 8 contacting a rigid non-displaceable back-up.

It can now be seen that there is provided a foundry molding machine squeeze head providing a uniform pressure over the entire upper surface of the sand mold during the squeezing operation utilizing both a compressible fluid and a displaceable yet incompressible back-up fluid.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

We, therefore, particularly point out and distinctly claim as our invention:

1. A squeeze head for foundry molding machines and the like comprising a downwardly opening cavity, a diaphragm peripherally secured to said cavity extending across the bottom thereof, a chamber in said cavity having a flexible wall vis-a-vis said diaphragm, a compressible fluid sealed in said cavity between said diaphragm and said flexible wall, and a substantially incompressible fluid sealed in said chamber.

2. A squeeze head as set forth in claim 1 including a generally centrally disposed rigid support for said diaphragm and flexible wall.

3. A squeeze head as set forth in claim 2 including a rigid pouring basin forming member projecting from said support.

4. A squeeze head as set forth in claim 1 wherein said flexible wall and said diaphragm are both peripherally secured to said cavity in vertically spaced relation.

5. A squeeze head as set forth in claim 1 including means operative to supply regulated low pressure air to said cavity between said diaphragm and flexible wall.

6. A squeeze head for a foundry molding machine comprising a horizontally compartmented chamber with a diaphragm partition and a flexible sand engaging wall, and fluids of different compressibility segregated by said diaphragm partition and sealed in such compartments.

7. A squeeze head as set forth in claim 6 wherein said flexible sand engaging wall comprises two relatively thick diaphragms peripherally secured to the bottom of said head.

8. A squeeze head as set forth in claim 7 wherein such fluids comprise water and air, such air being sealed beneath said compartmenting partition diaphragm, and such water being sealed above said compartmenting partition diaphragm.

9. The squeeze head as set forth in claim 8 including means operative to supply regulated low pressure air to said squeeze head, and means to trap such air in said squeeze head.

10. A squeeze head as set forth in claim 7 wherein such fluids comprise air and water, such air being adapted to be compressed and laterally displaced by engagement of said squeeze head with a sand mold and the like, and such water being adapted to be laterally displaced by engagement of said flexible sand engaging wall with said compartmenting partition diaphragm after such air has thus been compressed.

11. A squeeze head for foundry molding machines comprising a flexible sand engaging diaphragm peripherally secured to said head, an air chamber behind said diaphragm adapted to contain a fixed quantity of air-a liquid chamber behind said air chamber, a second diaphragm forming a common partition for said liquid and air chambers adapted to be engaged by said first diaphragm laterally to displace such liquid upon the application of said squeeze head to a sand mold and the like.

12. A squeeze head for foundry molding machines comprising a variable volume air chamber having a flexible sand engaging wall peripherally secured to said head, a fixed volume liquid chamber completely backing up said air chamber, and a flexible partition separating said air and liquid chambers.

13. A squeeze head as set forth in claim 12 including means to maintain a fixed quantity of air in said air chamber.

14. A squeeze head as set forth in claim 12 wherein said flexible sand engaging wall comprises two juxtaposed relatively thick diaphragms.

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