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MOLD FOR MAKING SHIP HULLS AND LIKE FLOATABLE STRUCTURES

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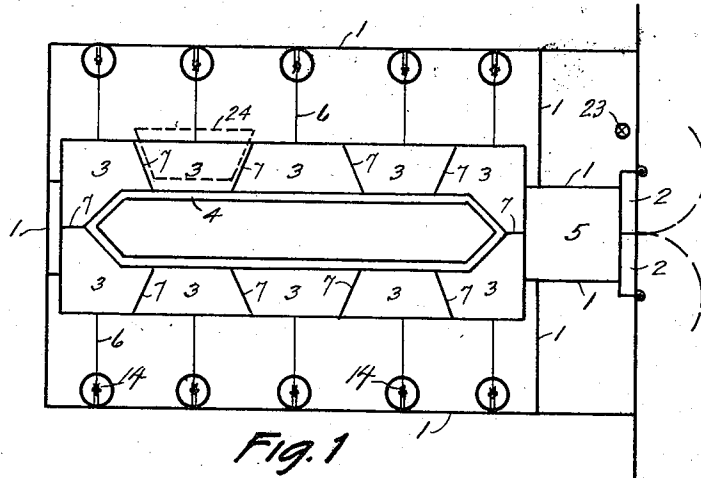


Fig. 1

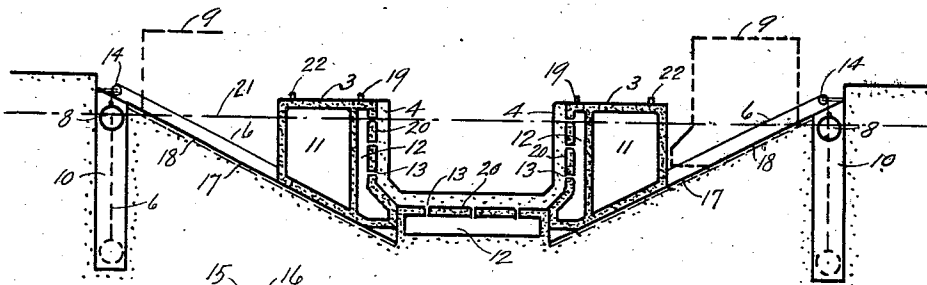


Fig. 2

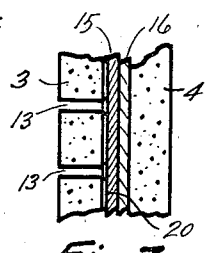


Fig. 3

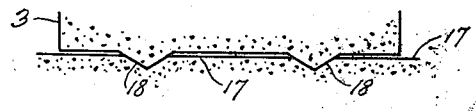


Fig. 4

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# UNITED STATES PATENT OFFICE.

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## MOLD FOR MAKING SHIP HULLS AND LIKE FLOATABLE STRUCTURES.

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*To all whom it may concern:*

Be it known that I, EDWARD A. LARSEN, a resident of Larkspur, in the county of Marin and State of California, have invented new and useful Improvements in Molds for Making Ship Hulls and like Floatable Structures, of which the following is a specification.

This invention relates to a device for forming bodies of cementitious materials, and is particularly useful for forming ship hulls, and like floatable structures of plastic material.

The principal object of my invention is to provide a mold which can be permanently used, time and again, in the successive molding of ship hulls in quantity production and with speed and economy.

The important feature of my invention is that the mold is built in an enclosed basin or drydock in which water, under control of valves or a seagate, may be either introduced or excluded at will, and by such introduction of water, cause the mold to be automatically dismembered and floated, so as to let free, when formed, the cast hull, and permit floatation thereof, and, conversely, by removal of the water from the basin, cause the reassembling of the mold to its original molding form.

To accomplish this object the mold is preferably built so that the tidal waters may, under control, enter or exit, to or from the mold. The mold is made in sections adapted to become buoyant and float immersed in the introduced water, and, while so floating and rising, as the water level raises, to be also drawn angularly sidewise away from the center of the mold, the sections being so drawn angularly up an inclined resultant line (on a guide track) formed by the combined vertical floating action and horizontal transverse action—and conversely, by allowing the waters to recede in the basin, the sections by virtue of the lowering of the water level or by their gravity will assemble again to molding form. Thus it will be seen that, varying the water level varies the positions of the constituted parts of the mold.

From the foregoing it will be clear that the salient feature of my invention is the

means for auto-assembling and auto-disassembling of the mold by respectively evacuating and introducing water into the basin—that is, the operation of the mold, by successive introduction and discharge of water. When the water is excluded from the basin and the mold is assembled, work begins and the hull is cast, and, when the waters are introduced into the basin the mold is dis-

membered and the hull is floated. The engaging faces of the mold sections at the joints may be angular to each other, in both horizontal and vertical cross section so that, the mold sections resemble the key-

stones or voussoirs of an arch. The vertical planes of the sections which engage at the joints being angular to each other, admit of the withdrawal of the sections separately or collectively without contacting one another and further, certain sections of the mold may be made so as to float previous to and in advance of their adjoining sections, this means permitting the mold sections to move uniformly without contact and to operate much easier than if the members were of rectangular shape, as no sticking or binding is possible.

The mold sections are kept drawn, under tension, sidewise by cables connected to counterweights reciprocating in wells, and, by this means the sections slide angularly on their tracks up or down the inclined surface of the dock or basin, in or out of position, as the water level raises or lowers. Means may also be provided such as a ratchet or brake to hold the members in disassembled form while the basin is free of water.

The molding walls have openings through them of a sieve character and are first coated with a soluble compound and then with a waterproof lining to hold the wet cement material forming the hull from leaking out of the mold and when the hull is to be floated the soluble compound dissolves by contact with the water and forms a slippery lubricant and the waterproof lining floats with the hull and adheres thereto. The bottom of the mold is integral with the dock and is made hollow so as to hold water to dissolve the compound.

Referring to the several figures:

Fig. 1, shows a plan of the drydock with mold therein for molding ship hulls.

Fig. 2, shows a transverse section through mold and drydock.

Fig. 3, shows a detail section through the molding walls of the mold showing the sievelike character and the holding reservoir back of same.

Fig. 4, shows a section of the guiding tracks for the travel of the mold sections up and down on the inclined surface of mold.

Referring to the drawing in which similar numerals refer to similar parts throughout the figures:

Numeral

1. shows the walls enclosing a drydock or basin below sea level.
2. a seagate opening from the dock to tidal waters.
3. floatable sections forming the mold.
4. hull cast in the mold.
5. passage to float ship out of basin to tidal waters.
6. cables to assist parts 3 inclinedly up and away from the cast hull.
7. joints between sections 3.
8. weights counterbalancing the parts 3.
9. shows by dotted lines the position of parts 3 and part 8 when mold is disassembled.
10. wells permitting weights 8 to rise and fall as mold operates.
11. cellular areas of part 3.
12. cellular areas of part 3, for receiving water or steam to dissolve the compound on mold parts 3.
13. openings through mold wall to pass liquid to dissolve compound 15.
14. pulleys to guide cables 6.
15. soluble compound on mold walls.
16. waterproof lining over compound 15.
17. inclined surface of basin.
18. guide track members on parts 3 countersunk into part 17.
19. inlets into areas 12 of parts 3 to introduce a liquid to dissolve the soluble compound 15 on mold walls by passing through the openings 13 in mold walls 20.
20. are the molding walls.
21. water level when the dock contains a body of water.
22. shows a sea valve for controlling the inlet and outlet of the tidal waters in the basin.
23. shows an inlet for injecting or ejecting a fluid into the cellular areas of parts 3 to make them heavier than water or lighter.
24. shows the position of a partly removed key section, which sections when withdrawn permit the withdrawal of the intervening sections.

The salient features of my invention are; the withdrawal of the mold's constituent parts, transversely along and angularly up

the inclined slope of the dock and the similar converse assembly of the said parts down the incline slope, the withdrawal of the keystone members, in advance of the counterpart members, in disassembling the mold, and the replacement of the counterpart members in advance of the keystone members in assembling the mold.

The destruction of the adhesive bond of the concrete material (forming the hull) to the mold walls by means of the soluble compound and waterproof lining the sieve character of the mold surfaces to introduce water between the hull and mold wall surfaces and the preferable placing of the mold in a position below the level of tidal waters or in a graving dock or in an enclosed water space communicating freely with a stream or harbor by a passage which may be closed by a seagate. Or on a floating submersible dock.

The operation of the mold is as follows:

The mold sections being assembled in molding form and the dock free of the water, the mold surfaces are first covered with a soluble compound and then lined with a waterproof material, reinforcement members (if any) may then be fabricated and the cementitious material to form the hull applied with a cement gun and then troweled to a finished surface.

When the hull is sufficiently matured, water, steam or other agent may be delivered into the cellular areas back of mold walls to dissolve the compound and at the same time the tidal waters may be allowed to flood the dock separating and floating the mold sections from the hull and floating the hull which may be towed to sea through the seagate. The mold may be made to cast hulls of smaller sizes and varying tonnage and shape than the original mold produces. This may be done by securing temporarily to the sectional part of the original walls supplementary forms adapted to give shape to the smaller hulls. In this case the sectional parts forming the original mold would function as a mechanical means in expanding and contracting the smaller molds. The mold may also produce a hull of a length less than the original mold produces, this can be accomplished by removing from the mold some of the sectional parts of the mold and crowding the balance of the sectional parts together to form the smaller hull.

It will be understood that while the above description describes the preferred embodiment of my invention variations in many particulars may be made without departing from the spirit of my invention.

For instance, the mold sections for forming the sides of the mold may be lighter than water, or heavier than water, the essential requisite being that they be of such weight as to be withdrawn from their position by the counterweights as they become

immersed as the water level raises and envelops them wholly or partly.

Or, the mold may be built in a river bed or like water basin so as to permit a hull to be molded during the drought of summer and floated from the mold during the flood tides of winter, in which case no dock, enclosures or control of impounded waters would be necessary.

10 What I claim is;

1. In the combination, including a graving dock and a molding device of the kind described therein, comprising a mold made in floatable sections adapted to be assembled and disassembled by respectively lowering and raising the level of water in which the mold is immersed and means for causing the said sections to move angularly upward and away from the center of the mold as the water level is made to raise and conversely means for causing the sections to move downward and toward the center of the mold as the water level is made to recede.

2. A mold adapted to be brought successively into positions for molding and also for releasing the product of the mold by lowering or raising the water in which the mold is inundated and means for operating the mold in such manner and means for enclosing and controlling the water for raising or lowering the level of same to accomplish this purpose.

3. A mold consisting of a plurality of floatable sections built in an enclosed basin below sea level and adapted to be brought into and out of molding position by varying the depth of water in the basin, and means for controlling the admittance or discharge of such water in the basin and means for removing the cast hull from the mold and basin.

4. A mold consisting of a plurality of separable floatable sections and having an inclined track adapted to guide the said floatable sections upward along the said inclined track and away from the central position of the mold and conversely adapted to guide the said floatable sections downward along the said inclined track towards the central position of the mold and hydraulic mechanical means to cause the mold to operate in this manner to accomplish the purpose stated.

5. A graving dock mold of the character described consisting of an assembly of parts adapted to be brought into engagement by lowering the water level in the dock and conversely adapted to be brought out of engagement by raising the water level in the dock and means for controlling the depth of water in the dock.

6. The combination including a graving dock and a mold of the kind described, constituted of an assembly of parts adapted

to be contracted or expanded by the rise and fall of the tide in the dock and means to control depth of water in the dock, means for applying supplemental temporary forms to the mold sections to form a mold within the original mold for casting hulls of smaller and various types, shape and tonnage substantially as described for the purpose specified.

7. A mold for casting ship hulls or like floatable structures consisting of a floor portion for shaping the bottom of the mold product, separable sections approaching a tetragon in shape for shaping the sides of the mold product, said separable sections being adapted to become buoyant when in contact with water whereby their withdrawal from the mold product may be effected and the mold product floated, means to operate and guide the said separable sections into and out of molding form as the water level lowers or raises, openings in the mold floor and walls to introduce water to release the mold product, a soluble compound on the mold surfaces and a waterproof lining covering said soluble compound.

8. A graving dock in combination with a mold of the kind described consisting of separable floatable sections of tetragonal shape, the molding surfaces of which have openings through the walls thereof, a cellular floor at the bottom of the graving dock having openings permitting water communication between the cellular area and the mold area of the floor, means for controlling the water level in the dock and means for exerting a tensional pull of the said floatable section to withdraw them from molding position when in contact with water let into the dock and means to guide the said floatable sections into and out of molding position.

9. In the combination with a floatable submersible dry dock, a mold adapted to be assembled and disassembled by varying the water level relative to the keel of the mold and means to cause the mold to operate as the water level varies.

10. A mold of the character described consisting of parts for forming the sides of the mold product, a floor portion for forming the bottom of the mold product and also for forming a base for supporting the said parts, means to cause the said parts to move away from the center of the mold as they are buoyed up by a body of water inundating the said parts and means to cause the said parts to move toward the center of the mold as the buoyancy of said parts ceases due to the lowering of the water level of the inundating body of water substantially as described.

EDWARD A. LARSEN.