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**METHOD FOR MAKING AN EARTH PIT MOLD
FOR A PLASTIC BOAT HULL****Robert L. Smith, 1331 33rd St.,
Bakersfield, Calif. 93301****Filed Sept. 13, 1966, Ser. No. 579,090****7 Claims. (Cl. 264—32)**

This invention relates generally to the making of a mold to duplicate very large plastic objects, such as a fiber glass boat hull.

More particularly, the invention relates to such a method in which a prototype hull is first coated in several layers to form a precisely fitting mold liner structure, and thereafter, a massive mold supporting structure is formed from successive applications of steel reinforcing, spray-deposited concrete, and tamped earth, within a mold-accommodating pit.

Plastic-covered fiber glass has become the most widely accepted material for small boat hulls. Beginning a few years ago with pleasure boat hulls ten or twelve feet long, fiber glass construction has slowly displaced wood as the most popular material in boat hulls of greater and greater length. At the present time, fiber glass boat hulls between thirty and fifty feet in length are not uncommon and may come to dominate the field.

Although such boat hulls are referred to as "small," because they are small in size relative to the full range of boats and ships, they must be considered as enormous plastic moldings, since they dwarf almost all objects molded from plastic outside the boat hull field. However, it will be understood that large objects other than boat hulls are being fabricated from fiber glass plastic, and the method prescribed herein is intended to be claimed with respect to other large objects, although its best present use and the following explanation of its application, is made with reference to a boat hull which is large with reference to the molded dories and outboard motor boats which have been mass-produced from fiber glass plastic in past years.

The construction of a mold for the larger plastic molded boat hulls has, in the past, required a major capital investment for each mold. It is a major object of the present invention to provide a method for making large molded boat hull molds at very low cost, once a prototype hull has been provided. Such a hull may be a fiber glass boat hull built from an extremely expensive prototype model or the prototype hull may be a wooden hull constructed by conventional means, which it is now desired to reproduce in fiber glass.

By means of the method herein disclosed, a number of relatively inexpensive molds may be constructed in order to expand production facilities. On the other hand, no costly and expensive mold of large size needs to be stored, as long as a single prototype of the desired boat hull is available from any source. Finally, a very large mold can be stored conveniently in many shipyards and boatworks, since the mold of the first construction is supported below the surface of the earth and may be filled in to ground level when not in use, and then excavated later.

Large boat hull molds presently constructed require massive external reinforcing. This reinforcing is generally of steel, and has several undesirable characteristics. It is subject to temperature expansion and contraction. The massive weight of the hull may cause the mold to be deformed in the later stages of construction. It is a major object of the present invention to eliminate most of the costly steel bracing and supporting structure, and to provide an even stronger structure comprised of reinforced concrete and tamped earth in an earth pit.

Another major object of the invention is to provide a

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massive boat hull mold in which the mold is lined with a fine, smooth, and perfectly duplicating liner surface, and supported on a mold support structure as previously mentioned, but in which the entire mold construction, both liner and mold support, are unitary and integrated in a single solid unit. Large molds of the past have often been subject to failure because the liner and the mold support were not truly unitary in construction, and one part yielded to the destructive deformation of the other.

The foregoing, and other objects and advantages of the invention will be understood from the following description of one preferred method for the practice of the invention, the steps of said method being illustrated in the accompanying drawings, in which:

FIGURE 1 is a perspective view of a prototype hull, which is shown suspended from the pulleys of a travelling crane, while it receives certain mold-release coatings;

FIGURE 2 is a transverse sectional view of the prototype hull of FIGURE 1, as it receives the plastic liner material which is used to form the precision fitting inner surface layer of the mold;

FIGURE 3 is a perspective view of a fragment of the prototype hull, shown partly in section, and revealing the step of attaching furring patches;

FIGURE 4 is a perspective view of the fragment of FIGURE 3, showing the step of attaching steel netting reinforcement spaced outward from the mold liner layer;

FIGURE 5 is a perspective view of the prototype hull, transversely sectioned at about mid-length, as it appears in the mold-supporting pit, after the application of cement;

FIGURE 6 is a transverse sectional view of the prototype hull and mold showing the step of tamping earth into mold-supporting position;

FIGURE 7 is a perspective view of an enlarged fragment of hull, mold, and earth, seen partly in cross-section, and showing the wedge and water nozzle used for achieving the separation of the prototype hull; and

FIGURE 8 is a transverse sectional view of the mold pit and the prototype hull as it is lifted out of the pit-supported mold produced by the process of the invention.

In FIGURE 1, a prototype hull 10, which it is desired to reproduce, is shown in perspective as it is suspended from a crane. Usually, the prototype will itself be a fiberglass plastic boat, but it is to be understood that the method of the invention is well-suited to making fiber glass reproductions of suitable steel or wood hulls.

Since the mold will exactly reproduce the surface of the prototype, a first and important step is to render that surface as perfect as possible. The entire surface should be finished to perfect contour and nearly perfect smoothness, by patching, if necessary, and then finishing to a smooth, slick and glasslike surface by any suitable finishing means; for example, by means of fine sandpaper and rubbing compound.

The next two steps are concerned with applying two very thin coats of mold-releases material, which will play an important part in securing the release of the prototype hull 10 from the final and completed mold. In the preferred method, the smoothly finished prototype 10 is first sprayed with a thin layer of any standard mold wax, as indicated by the spray gun 11. When the wax coat has suitably dried, the entire surface is sprayed a second time, this time by a water-soluble mold release agent; for example, a very suitable release agent for this step is a polyvinyl-alcohol-silicone material in liquid form. The spraying of this second release material is indicated by the spray gun 12, and the two different coatings are indicated in FIGURE 1 by the surface texturing at 13 and 14 respectively.

After the two, relatively thin release coatings have been applied, as described in connection with FIGURE 1, a

mold liner layer, precisely conforming to the prototype hull, and providing a perfect mold surface, is deposited on the suspended prototype hull over the already deposited release coatings, as indicated in FIGURE 2. The liner coat is formed by two spraying steps indicated in FIGURE 2 by the spray guns 15 and 16.

Spray gun 15 deposits a coat of polyester tooling gelcoat, approximately 20 mils in thickness. This material is the first layer of the mold that is being made, and becomes the exposed inside surface of the mold.

Next, spray gun 16 deposits a mixture of polyester resin, catalyst, and chopped fiberglass, approximately one-quarter of an inch in thickness. This material constitutes the walls of the mold.

In the drawing of FIGURE 2, the mold release coatings and the gelcoat are treated as so thin as not to be possible to represent in the cross-sectional portion of FIGURE 2 at the region 17. However, the fiberglass material is represented as a layer visible in cross-section over the rest of the prototype hull at 18.

While the resin and fiberglass layer 18 is still fresh and tacky, pieces of cardboard or similar material, approximately 2 inches square and $\frac{3}{8}$ inch in thickness are placed in position, at spaced intervals, over the tacky polyester surface, as seen in the enlarged fragmentary view of FIGURE 3. These pieces are used as furring blocks to support steel reinforcing mesh at suitable spacing away from the polyester surface. The spacing is not critical, but should be sufficiently close to insure good strength and adhesion for the subsequent steel reinforcing mesh and concrete. The furring blocks are indicated in FIGURE 3 by the numeral 21.

In the next step, illustrated in FIGURE 4, steel reinforcing mesh, such as one-inch stucco netting, indicated by the numeral 22, is attached to the furring blocks 21 by means of staples 23 or the like, so that the mesh is supported spaced outwardly from the polyester and fiber glass mold layer.

The next step is to form the massive concrete shell portion of the mold, which entirely encloses and supports the mold liner comprised of gelcoat 17 and fiber glass 18. This layer is so massive that it cannot be formed and retained on the prototype hull 10 as it is suspended in the manner illustrated in FIGURES 1 and 2.

Instead, the concrete shell is built up with most of the weight supported in an earth pit as illustrated in FIGURE 5. The fiber glass-coated hull described in connection with FIGURE 2 is transported by the crane 25, and lowered into a large earth pit indicated in FIGURE 5 by the numeral 26. Just before the hull 10 is lowered into pit 26, a pad of wet cement, about one foot thick, is deposited by the gunnite method in the bottom of the pit 26 at 27, the initial pad being indicated by the numeral 28. The bottom of the fiber glass-covered prototype 10 is allowed to rest on the pad 28, but the hull 10 continues to be suspended from the crane 25 in an upright position, leaving a space 29 exterior to the prototype hull 10 and its preliminary fiber glass covering 18. Preferably, this space 29 is about four feet larger, all the way around, than the prototype hull 10, so that there is ample room for workmen to get into the pit and to perform the next step of depositing the gunnite concrete layer, which is indicated in FIGURE 5 by the numeral 30.

The step of forming concrete layer 30 by gunnite spraying is carried out while the prototype hull 10 is suspended as shown in FIGURE 5, to a thickness of about 4 inches in a typical case. Of course, this entirely encloses the mold liner layers of gelcoat 17 and fiber glass 18, as well as the furring blocks 21 and the steel reinforcing net 22.

When the gunnite layer 30 has been completed, the hull 10 and the mold layers 17, 18, and 29 appear as illustrated in FIGURE 5.

After the concrete has hardened, earth is filled in to the space 29 as illustrated in FIGURE 6, being tamped

into position as the filling proceeds. For example, a pneumatic tamper 31 may be employed.

It will be seen that a mold 32 has now been fully constructed and is now supported by the filled pit 33.

It is now necessary to release the prototype hull 10 from the mold 32, as illustrated in the enlarged detail of FIGURE 7. Release is achieved by driving small wedges 40 between the outer surface of the prototype hull 10 and the liner face layer 17 of the mold 32 at spaced intervals along the upper line of contact between the two. The use of these wedges creates a small opening indicated by the numeral 41 between the prototype hull 10 and the mold 32, and water under pressure is forced into the space 41 by any suitable means, but in the illustration, by hose 42 and nozzle 43. Water thus introduced under pressure into space 41 washes away the soluble mold release coating 14, and permits the prototype hull 10 to be lifted clear of mold 32 by crane 25 as illustrated in the transverse sectional view of FIGURE 8.

It will be evident that the mold 32 is rigidly and firmly supported over its entire surface by the tamped earth 33, so that it is unlikely that the gunnite layer 30 or the liner layers 17 and 18 will ever crack or deform as a result of lack of adequate support, even under heavy use and the introduction into the mold 32 of heavy weight.

The mold 32 is now ready for the building of a new hull by spraygun deposition of glass fibers and resin. Of course, before spraying has begun, the entire liner surface (gelcoat surface 17) should be covered with suitable mold release agents, such as the water soluble agent 14 and wax layer 13.

In larger hulls, some type of reinforcing elements may be suspended before any fiber glass spraying is done, or at some stage after a certain amount of fiber glass material has been laid down. For example, steel keel members, reinforcing panels, steel engine bases, trans members may be used. Wood beams, laminated wood, pre-formed plastic laminations, or metal reinforcements of stainless steel or brass may be embedded in the fiber glass plastic design.

The fiber glass boat hull, or other like item of construction is built up in a manner well known to those familiar with the art of fiber glass-plastic construction. Ordinarily, a combination of three spray guns simultaneously deposit, at substantially the same spot, particles of fiber glass filler, catalysts, and resin respectively. The liquid binder resin may comprise any of a number of suitable resins, such as one of the synthetic polyesters, epoxide, or phenolic resins containing cure-promoting agents. Likewise, the catalysts may be of any of a number of known and commercially available catalysts suitable for the resin used. Usually, the resin gun will blow the polyester resins in liquid form, whereas the catalyst gun may deliver a jet of powdered cobalt catalyst. The blown mix is built up to desired thickness as the cluster of guns is moved about to form the hull.

It will be seen from the foregoing description that I have provided a novel and extremely economical method for building boat hulls of the largest size deemed practical for fiber glass construction. It should be understood that the scope of the invention is not limited to the details and precise dimensions set forth for purposes of illustration in the foregoing example, which was described in specific detail. Instead, all modifications, variations, and improvements which fall within the scope of the following claims are included within the scope of the present invention.

What is claimed is:

1. A method for making a mold for reproduction in plastic construction of a prototype hull or the like, which method includes the steps of:

preparing a surface of said prototype hull with a coating of water-soluble mold release material;
depositing a mold liner layer of plastic material over said mold release coating;

attaching furring spacers to said plastic coating;
 curing said liner coating;
 attaching reinforcing means to said furring means;
 supporting said prototype hull in an upwardly opening
 position in an earth pit having sides spaced away
 from the outer coated sides of said hull partly by
 suspension from above and partly by resting the
 lowermost surface of said hull in a pad of soft con-
 crete in the bottom of said pit;
 spraying a wet concrete mixture over the plastic coat-
 ing, and said reinforcing and furring means, on the
 outer surfaces of said hull to make a rigid mold sup-
 port structure in the form of a concrete shell in-
 tegral with said liner layer;
 after said concrete shell has hardened, filling the space
 in said earth pit outside the shell with packed earth
 to firmly support said mold; and
 introducing water between the outer surface of said
 prototype hull and said mold liner layer, to wash
 away said water soluble mold release material and
 permit the withdrawal of said prototype hull.
 2. A method as described in claim 1 in which:
 said furring spacers are attached to said plastic coat-
 ing by adhesion in said coating while said coating is
 still in an uncured and tacky state.
 3. A method as described in claim 1 in which:
 said preparation of the surface of said prototype hull
 comprises forming a two-layer mold release coating
 on the prototype surface by first spraying said sur-
 face with a suitable mold wax, and then spraying
 said wax-coated surface with a water-soluble mold
 release coating comprised of a silicone material
 transported in the spray of a readily vaporizable
 organic solvent.
 4. A method as described in claim 1 in which:
 said mold liner layer is formed by spraying onto said
 mold release coating a structurally rigid layer com-
 prised primarily of plastic material incorporating
 catalysts and fiber glass filler;
 and said furring means are pressed into position on
 said fiber glass-plastic coat while it is still in an un-
 cured and tacky condition.
 5. A method as described in claim 4 in which:
 said prototype with said applied coatings, furring
 spacers, and reinforcing means is placed in said
 earth pit with most of the weight of said prototype
 supported on a pad of concrete which is still in a
 wet and unhardened condition, so as to accommodate

the lowermost surface of said prototype; and the
 mold shell structure is subsequently completed by
 gunnite spraying the sides of said coated prototype
 to fully enclose and cover said furring blocks and
 said reinforcing means
 6. A method as described in claim 1, in which:
 filling the space in between the outer surfaces of said
 mold shell and the sides of said pit and tamping said
 earth into compacted condition to provide rigid sup-
 port over the entire outer surface of said mold shell;
 spaced openings are formed between the upper periph-
 eral edge of said prototype and said concrete shell,
 prior to the hardening of the concrete; and
 said prototype hull is separated from said concrete,
 subsequent to its hardening by the introduction of
 water under pressure into said spaced openings.
 7. A method as described in claim 1 in which:
 said mold liner, said furring spacers, and said reinforc-
 ing means are attached by the following steps;
 forming a two-layer mold liner by first spraying on
 said mold release coating a layer of plastic gelcoat,
 and after curing of said gelcoat, spraying on a struc-
 turally rigid layer of plastic material incorporating
 catalysts and fiber glass filler;
 attaching furring blocks to said liner by pressing said
 furring blocks into position on said fiber glass-plastic
 coat while it is still in an uncured and tacky condi-
 tion; and
 attaching a reinforcing mesh to said furring blocks by
 fastener means penetrating said blocks.

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