E. A. LARSEN.

COMPRESSOR MOLD FOR FORMING CONCRETE HULLS.

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1,343,176.

Patented June 8, 1920.

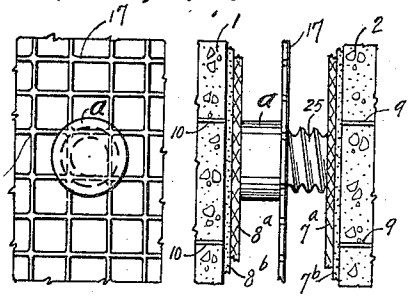
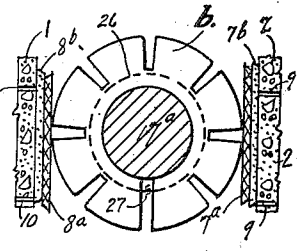


Fig. 3



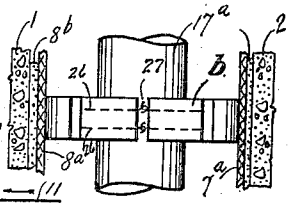


Fig. 4

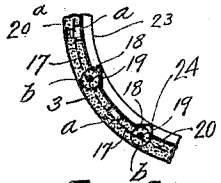


Fig. 5

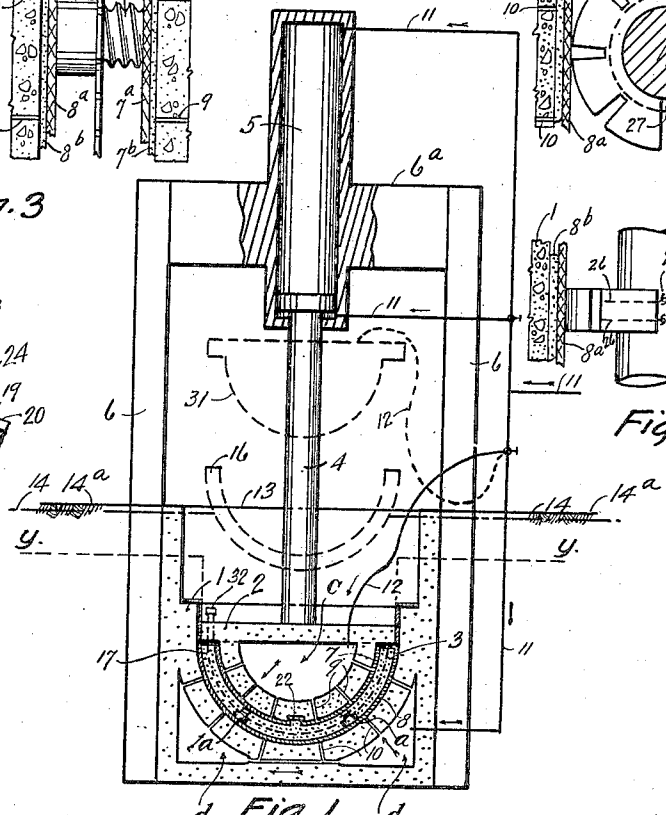


Fig. 1

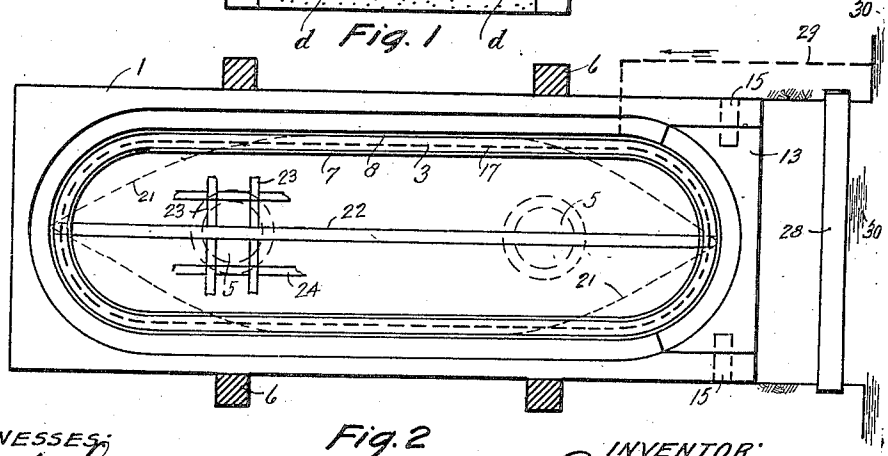


Fig. 2

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COMPRESSOR-MOLD FOR FORMING CONCRETE HULLS.

1,343,176. Specification of Letters Patent. Patented June 8, 1920.

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To all whom it may concern:

Be it known that I, EDWARD A. LARSEN, a citizen of the United States, and resident of Larkspur, in the county of Marin and State of California, have invented a new and useful Improvement in Compressor-Molds for Forming Concrete Hulls, of which the following is a specification.

This invention relates to a molding apparatus for forming reinforced concrete hulls of boats, ships, barges and like floatable structures. The principal object of my invention is to provide a permanent mold for quickly and cheaply making repetitive boats of a set type or design. Other objects of my invention are to make a boat with hull walls as thin as possible consistent with strength and impermeability to moisture and to hold the fabricated steel reinforcement of the concrete in a position where maximum strength may be obtained and a safe covering of concrete insured to guard against erosion of the steel.

I accomplish the object of my invention by providing a mold in two parts; a concave lower part for forming the exterior shape of the hull and a convex upper part for forming the interior shape of the hull, the two conforming parts being adapted to engage and compress by power the liquid concrete (which has been previously deposited in the concave lower part of mold) into the form of a hull or shell of a boat. For the purpose of preventing the adhesion of the concrete hull to the upper and lower mold parts the surfaces of same are first coated with a compound, dissolvable by contact with water or steam, after which a waterproof lining is applied over said compound, the wet concrete of the hull impacting directly upon the said waterproof lining. Both the upper and lower mold walls are provided with openings through same communicating with cellular areas around same, the plan being to force water, steam or other agent into said cellular areas, from which it finds its way into said openings and finally contacting and dissolving the said dissolvable compound and forming an air space for freeing the hull. When the cast hull is sufficiently set the hydraulic pressure cylinder may be operated and the upper part of the mold raised out of the hull. A screw jack or other mechanical device may be used if preferable for lowering and raising the upper part of mold, or the sheer weight of the upper part of mold may be sufficient to produce pressure for compressing the hull.

The lower part or concave part of the mold is set sufficiently below the level of adjacent waters to allow said waters to flow into said concave part of mold. During the molding of the cast hull the waters are excluded from the mold by a seagate and allowed to flow into the mold, under control of a valve, when the hull is to be floated. The seagate is then opened and the hull towed out on the adjacent waters. Means are provided by which the steel fabricated members are retained in their proper places in the concrete, during the molding process; these consist of cast concrete members secured to the steel members, forming projections on same and preventing the said steel members from coming in contact with the mold surfaces by first contacting the said surfaces themselves. A sufficient covering of concrete is thereby insured around the steel members. The said cast concrete members incorporate themselves into the cast hull and form part of same.

During compression of the upper mold into the lower mold, in the process of forming a hull, these said concrete members form a limit of compression by the upper mold part impinging and coming to rest on same, thus guaranteeing a uniform thickness for the shell of the hull corresponding to the size of the concrete members used. Various thicknesses of hulls can therefore be made by varying the thickness of the said concrete members. Parts of the mold at the seagate end of same may be made dismemberable so as to allow the cast hull to float easily out without fouling portions of the mold. An important feature of my invention is, that by the compression process all air is excluded from the concrete mixture forming the hull, as are also voids which are caused by chemical action during the setting of the concrete. The concrete being forced to set under pressure forms a shell impervious to moisture, all interstices being filled and a perfect bond between the steel and concrete being the result. If need be the mold can also be used as a simple pouring mold by setting the upper and lower mold parts at a suitable distance apart and pouring the concrete into the intervening space or through opening provided for this purpose.

The operation or the molding of a concrete

hull is as follows: Water is first removed from lower mold 1 by pumps provided for this purpose, and also for operating the hydraulic cylinder press 5. The upper mold 2 in raised position 31 is covered with a dissolvable compound 7^b over which a waterproof lining of fabric or paper 7^a is closely laid with sealed joints. The lower mold 1 is then treated in like manner. The steel mesh 17 is now fabricated in place in lower mold 1 after which the steel bars 17^a forming the steel frame of the hull 3 are set. A sufficient quantity of concrete is now deposited in the lower concave mold 1, the hydraulic cylinder 5 directly connected by means of plunger 4 to upper mold part 2 is operated for a down stroke, causing the upper mold part 2 to detrude into the lower mold part 1 and plunge into the liquid concrete in same, which causes the liquid concrete to force itself throughout the mold and shape itself into a hull 3 in conformity with the molds 1—2. The upper mold part 2 is brought to rest by impacting against the concrete spacing or steel retaining members *a* and *b*, which determine the thickness of the concrete hull 3. The concrete formed hull 3 is allowed to set under pressure and when ready to be withdrawn from the molds 1 and 2 a fluid or gas, but preferably water is introduced under pressure into cellular areas *c* and *d* by means of pipes 11 and 12, from cellular areas *c* and *d;* water is forced through openings 9 and 10 in walls of molds 1 and 2, causing a dissolution and hydraulicking of the dissolvable compound 7^b and 8^b, leaving an air space for freeing the hull 3. The upper mold 2 is now withdrawn by an upstroke operation of the hydraulic cylinder press 5, to position 31. Water is allowed to flow into the lower mold 1 from the adjacent waterway 30 through pipe 29 and the cellular areas *c* and *d*, and through openings 10, causing flotation of the cast hull 3, the water proof lining 8^b may be removed, the seagate 28 and the end of mold 13 opened and the hull 3 towed to adjacent waterway 30.

Referring to the drawing similar numerals refer to similar parts throughout the several views and in which—

Figure 1 shows a vertical section of molding press. Fig. 2 shows a sectional plan view of same on line *y*,*y* with hull omitted. Fig. 3 shows a detail elevation and section of concrete members for retaining fabric in place. Fig. 4 shows a detail sectional view and plan view of concrete members for retaining reinforcing steel in place. Fig. 5 shows a section of hull shell showing longitudinal ribs (which may be omitted if desired, as shown in 3 Fig. 1) showing application of "*a*" Fig. 3, and "*b*" Fig. 4.

Numeral 1 shows main body or lower part of mold, showing depressed conform for shaping the exterior of the hull. Numeral 2 shows the convex or upper and detruding part of mold for shaping the interior of hull. Numeral 3 shows the cast hull compressed between the two molding surfaces. Numeral 4 hydraulic ram shaft. Numeral 5 hydraulic cylinder. Numeral 6^a supporting girder for same. Numeral 6 supporting columns for hydraulic cylinder. Numeral 7 shows the dissolvable compound and water proofing between 2 and 3. Numeral 8 shows the same between 1 and 3. Numerals 7^a and 8^a show dissolvable compound. Numerals 7^b and 8^b show waterproof lining. Numeral 9 shows openings through mold wall 2. Numeral 10 shows openings through mold wall 1. Numeral 11 shows pipe for carrying a fluid or gas, or other media for operating the hydraulic cylinder and for dissolving the dissolvable compound. Numeral 12 shows a flexible pipe for conveying said fluid to interior of mold part 2. Numeral 13 shows a dismembering part of mold to allow a horizontal draft of cast hull out of same. Numeral 14 shows the water line. Numeral 14^a shows ground line. Numeral 15 shows tenon for locking part 13 to part 1. Numeral 16 shows position of floated hull. Numeral 17 shows reinforcing fabric in cast hull. Numeral 17^a shows reinforcing bar Fig. 5. Numerals 18 and 19 show top and vertical sides of longitudinal ribs 24. Numeral 20^a shows the inner wall surface of hull. Numeral 20^b shows the outer wall surface of hull. Numeral 21 shows water line of hull. Numeral 22 shows keel of hull. Numeral 23 shows transverse ribs of hull (not continued across hull). Numeral 24 shows longitudinal ribs of hull (not continued along hull). Numeral 25 shows screw part of "*a*." Numeral 26 shows reinforcing wires in concrete, retaining member "*b*." Numeral 27 shows wire tie in same. Numeral 28 shows seagate vertically reciprocating in pocket for same. Numeral 29 shows inlet pipe from adjacent waters to lower part of mold for floating hull by flooding said lower mold part. Numeral 30 shows adjacent excluded waters. Numeral 31 shows withdrawn position of mold part 2. Numeral 32 shows inlet plug for pouring concrete into mold.

a concrete retaining members for fabric.

b concrete retaining members for other steel reinforcement.

c shows cellular area in part 2.

d shows cellular areas in part 1.

The concrete spacing members "*a*" for retaining the wire lath or similar fabric in its position in the concrete consists of a threaded plug having a head forming a shoulder at one end. The plug is screwed into the mesh of the wire lath up to the shoulder, allowing the plug to project on both sides of the mesh; various size plugs

can be used for various thicknesses of hulls and the plugs may be grooved so as to form a key into the concrete.

The spacing members "*b*" consist of a series of blocks molded in common to a strap of concrete in which wires are embedded. These are made in straight runs and may be cut in lengths to suit the size of steel bar each is intended to link around. Several winds around a bar may be made in a helical fashion and no wiring is necessary to hold them on the bars.

What I claim is:

1. The combination including a fixed graving dock forming a mold for the exterior of a hull of a ship to be molded and having perforated walls through which liquid may be admitted to float the ship, a plunger of the shape of the interior of the hull and means for operating the same to compress concrete to the mold, substantially as described for the purpose specified.

2. The combination including a mold for the exterior of a hull of a ship to be molded, a plunger mold of the shape of the interior of the hull and means for operating the same to compress concrete in the mold, means in the mold parts through which liquid may be admitted for removing the hull from the mold parts, a compound on mold walls adapted to be dissolved by liquid admitted into the mold and a waterproof lining over said compound forming a watertight mold and preventing of leakage of wet concrete from the mold, removable sectional parts of mold at stern end of same for destroying mechanical bond of hull to mold, and a seagate permitting cast hull to be floated out of the mold.

3. A ship hull molding device comprising a mold of the shape of the ship hull built wholly or partly below water level, a mold of the shape of the interior of a ship adapted to detrude into the said mold of the shape of a ship hull and means for operating same to compress concrete in the mold, openings in mold parts to admit liquid through same, a dissolvable compound next the mold surfaces adapted to be dissolved by liquid admitted into the mold, and a metal lining over said compound to prevent leakage of concrete from the mold, a sea gate to exclude waters from mold and means to introduce liquid between hull and mold parts to float the ship hull.

4. A mold for receiving concretious material and forming same into a ship hull or like structure, said mold comprising outer and inner forms having openings permitting the passage of liquid into the mold for separating said hull from mold parts, a soluble compound on mold walls, a waterproof lining over said compound containing a metal fabric and means for permitting the ship hull to be floated from mold by introducing a liquid between hull and said outer form.

5. In a combination with claim 1, reinforced concrete spacing members adapted to be placed in the mold for governing the thickness of the hull and retaining the metal reinforcement of the hull in a set position therein; the said spacing members being mechanically secured to the metal reinforcement in the lower mold, and adapted to be incorporated in the poured concrete hull as for the purpose specified.

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Witnesses:
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