

[72] Inventor **William B. McLean**
3532 Lowell Way, San Diego, Calif. 92106
 [21] Appl. No. **832,566**
 [22] Filed **June 12, 1969**
 [45] Patented **Aug. 10, 1971**

Primary Examiner—Robert D. Baldwin
 Attorneys—Justin P. Dunlavey, Ervin F. Johnston and Thomas
 G. Keough

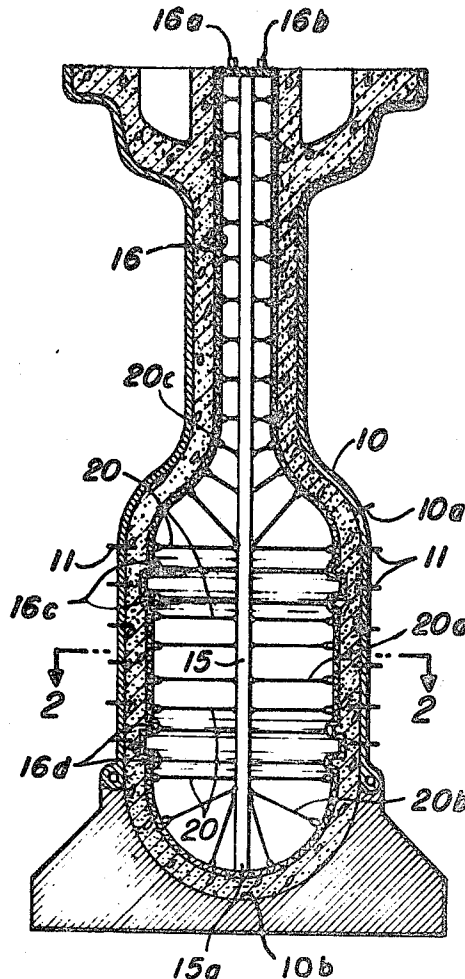
[54] **APPARATUS FOR CONSTRUCTING A BOTTLE-SHAPED MODULE**
 1 Claim, 4 Drawing Figs.

[52] U.S. Cl. 249/65,
 18/DIG. 14, 25/128 D
 [51] Int. Cl. B28b 7/32
 [50] Field of Search 25/128 D;
 249/65; 18/DIG. 14

[56] **References Cited**
UNITED STATES PATENTS

2,343,005	2/1944	Gardner	249/65
2,517,902	8/1950	Luebke	264/91
3,223,759	12/1965	Williamson	25/128 X

ABSTRACT: Casting a unitized bottle-shaped module having no seams or unsecured junctures is provided by forming a shell-shaped casting void between a conventional, external shell mold and a similarly shaped flexible baglike inner form carried on an elongate support member. A plurality of trammel tie wires of discrete lengths joins the bag and the support member to limit the degree and manner of extension of the flexible bag as fluids fill its interior. The bag, performed according to the inner dimensions of a bottle-shaped module, provides an inner surface for mold and is equal-distantly spaced from the inside of the outer form. As a casting material, e.g., concrete is poured into the casting void, water and/or pressurized air is passed to the bag's interior to provide a sufficiently strong retaining wall capable of counteracting the lateral force produced by the casting material before it hardens. After the concrete hardens, removal of the fluid from the interior of the bag allows its collapse, and the support member, tie wires, and bag are withdrawn from the cast module. Thusly, a unitized cast flotation module is provided having no seams, lines of joinder, or similar areas structurally weaker than the remainder of the casting.



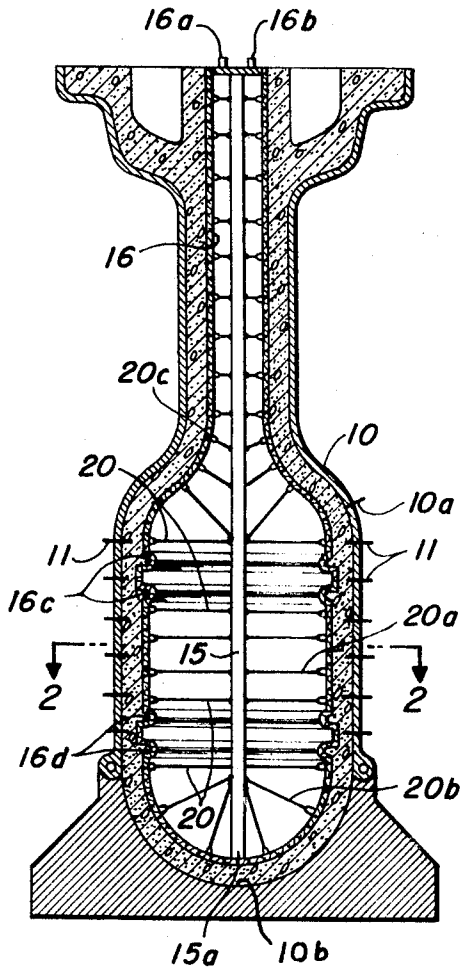


FIG. 1

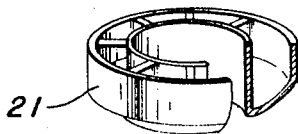


FIG. 3

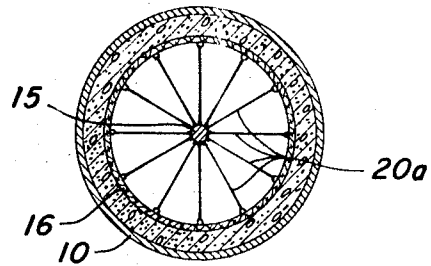


FIG. 2

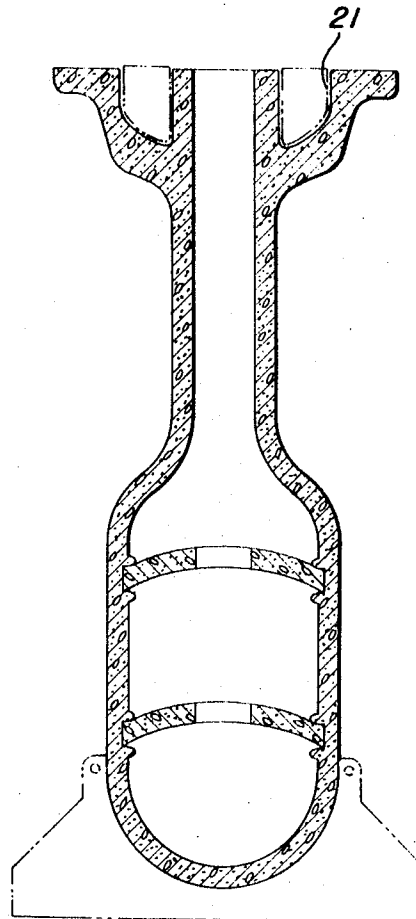


FIG. 4

INVENTOR
WILLIAM B. McLEAN

BY

Thomas G. Keough
Ervin F. Johnston

ATTORNEYS

APPARATUS FOR CONSTRUCTING A BOTTLE-SHAPED MODULE

BACKGROUND OF THE INVENTION

A conventional method of making tubular or bottle-shaped castings involves the casting of two identical sections, each being one-half of the total as bisected by a plane passing through its longitudinal axis. The internal and external casting forms are removed when the casting material hardens and the two halves are joined either by mechanical, external bands or adhesives. Obviously, the line of juncture between the two sections exhibits different shear, tensile, and compressive limits than the rest of the casting. In addition, self-destructive forces may be created by improper joiner to further weaken the overall structure. Another obvious disadvantage of a seamed structure becomes apparent when such structures are to be employed in water since most joiners are not watertight and tend to leak. Forming a bottle-shaped concrete module of unitized construction greater than 200 feet in length for use as a flotation element in a floating platform, focuses on the construction problem of providing external as well as internal molds capable of supporting and retaining the considerable bearing and lateral forces that up to 1,000 cubic yards of setting concrete exerts. A barrel stave or a clamshell outer mold suffices to form the outer casting surface since these forms are shored and braced adequately according to known techniques. A similar internal stavewise arrangement is feasible; however, such an internal mold is prohibitively expensive and requires an undue amount of time for assembly and disassembly between casting operations.

SUMMARY OF THE INVENTION

The present invention is directed to providing an apparatus for constructing a unitized casting having an opening. A conventional external shell shaped with an internal chamber communicating with the opening forms the exterior of a bottle-shaped casting. An elongate support member extending through the opening to the interior of the chamber carries a flexible bag, preformed according to desired dimensions of the casting's interior. The bag is held or maintained in its preformed configuration by a plurality of tie wires radially interconnecting it to the support member. As the casting material, preferable concrete, is poured into the shell-shaped volume defined between the outer shell and the flexible bag, a fluid such as water or similar liquid is ducted inside the bag to provide the lateral support necessary to hold the setting concrete. As more concrete is poured, more water is added to fill the bag to provide the necessary lateral support. Optionally, after a certain waterhead is attained, pressurized air is fed to the bag's interior to avoid the weight problems an up to 200-foot waterhead creates.

Therefore, an ultimate object of the instant invention is to provide an internal mold for a unitized bottle-shaped module.

Another object is to provide an internal mold for a bottle-shaped module easily assembled and disassembled with a minimum amount of time.

A further object is to provide an internal mold ideally suited for forming a casting surface capable of supporting up to 200 feet of setting concrete.

Still another object is to provide an internal form capable of supporting a considerable lateral load while being relatively lightweight in itself.

These and other objects of the invention will become apparent from the ensuing specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a cross-sectional view of the invention disposed within an outer casting shell to form a casting mold;

FIG. 2 is a lateral cross-sectional view of the invention taken along line 2-2 in FIG. 1;

FIG. 3 is a perspective view of a form used with the invention;

FIG. 4 is the cross-sectional view of the concrete bottle-shaped module having lateral decks.

PREFERRED EMBODIMENT OF THE INVENTION

The instant invention is particularly adaptable for forming elongate bottle-shaped flotation modules cast as a unitized structure of a homogeneous material or cast with reinforcing rods and mesh embedded in concrete.

A concrete bottle-shaped flotation module, as depicted in FIG. 4, obviates environmental reactive defects found in steel structures since concrete is relatively unaffected by the corrosive agents found in an ocean environment. A representative flotation module, having a longitudinal dimension of approaching 200 feet and a diametric dimension of approximately 50 feet, places the center of buoyancy considerably below an area of surface wave turbulence and its neck portion is of sufficiently small cross-sectional area to have a minimal surface reaction. An internal mold, capable of laterally supporting 200 feet of setting concrete and being removable through the narrow neck portion of the bottle-shaped casting, is provided by the instant invention.

An external form for shaping the outer dimensions of a bottle-shaped module is provided by well-known contemporary techniques, for example, as in FIG. 1, the outer form can be a hinged clamshell 10 arrangement or a barrel-stave form with retaining loops of steel. Because of the relative great weight of concrete or reinforced concrete, the base of the mold is sufficiently stressed to withstand the bearing force exerted by the weight of the casting. The external shell is braced and shored accordingly to hold the lateral forces attributed to concrete prior to its hardening. When reinforcing rods and mesh are included, a plurality of hangers, shown as short supporting pegs 11 retractably extending through correspondingly sized holes provided in shell 10, support the reinforcing rods and mesh until the concrete begins to set. When the concrete hardens, they are withdrawn from the casting, noting a withdrawn supporting peg 10a having its formerly innermost portion positioned in a substantially flush relationship to the inner surface of the outer form. The pegs, preferably, are withdrawn at the point of time when the setting concrete is still plastic enough to settle into the void created by the removed peg to preserve the integral unweakened nature of the bottle-shaped module.

A sufficiently stressed inner mold capable of supporting up to 200 feet of hardening concrete, conventionally, is fabricated of heavy steel plates and an interconnecting steel girder bracework. Heavy duty cranes and hoists, as well as considerable manpower, are required to position and assemble such a heavy steel internal form. In addition, the internal steel form must consist of a great number of small parts, small enough to enable their removal through the neck portion of a bottle-shaped casting to permit their reuse in subsequent casting operations. In the alternative, leaving the steel forms inside a cast module would be a prohibitively expensive waste.

The invention includes an elongate inner supporting shaft 15 positioned inside outer form 10 with a bottom-most extension 15a suspended a predetermined distance from the upper surface of a hemispherically shaped bearing support 10b. A flexible, but substantially inelastic airtight bag 16 is configured to define the inner dimensions of a bottle-shaped mold and is equal-distantly spaced from the inner surface of the outer form.

The bag is constructed of a rubberized canvas or any flexible, but relatively inelastic material that is rugged enough to hold together during the casting operation. The bag's dimensions are variable to permit the casting of modules having the desired thickness. A plurality of radially extending tie wires 20 are secured to the flexible bag and the supporting shaft to limit the bag's displacement.

As is apparent in FIG. 2 with respect to one set of radially extending tie wires 20a, the length of all of the wires extending along one lateral plane is substantially identical to uniformly shape or uniformly restrict the degree of extension permissible for the flexible bag. Sets of wires 20b and 20c disposed to sup-

port the hemispherically shaped bottom and the narrowing neck section, respectfully, are oriented to maintain these sections in a curved shape. These sets of wires are connected along the inner supporting shaft 15 to orient the individual wires in a perpendicularly supporting attitude with respect to the bag to produce no counteracting opposed tensile forces in the bag surface. Those sets of radially extending tie wires found in the cylindrical-shaped neck portion of the bag are substantially identical to those shown in FIG. 2, the only difference being that these sets are shorter.

The techniques employed for connecting the wires to the shaft and bag have not been elaborated on since there are many and varied methods. A typical manner of attachment involves bonding an eye-carrying strip of material on the inner surface of the flexible bag and providing appropriately disposed eyes welded onto the supporting shaft.

A considerable weight reduction is realized by providing a substantially annular upper steel form 21 configured to cooperate with the outer form 10 and the flexible bag 16 to define a flared outer surface for supporting a horizontal platform. Additionally, provision is made to include a means for coupling adjacent modules together.

The upward facing hemispherically shaped bearing support 10a, the inner surface of the outer form 10, and the outer surface of flexible bag 16, as well as the outer surface of the upper steel form 21, are coated with a grease or similar lubricant for permitting the extraction and removal of a hardened concrete module.

Using the invention calls for its being inserted inside of the outer form and, via the water, or optionally, gas inlets 16a and 16b, sufficient fluids are passed into the airtight bag to shape it essentially as shown in FIG. 1. As concrete is poured into and begins to fill the shell-shaped cavity between forms 10 and 16, lateral pressure begins to build up which tends to inwardly collapse the flexible bag. Adding more fluids through the inlets introduces a sufficient laterally counteracting force to withstand the lateral force of the unhardened concrete. Pumping out the fluid after the concrete hardens through inlets 16a and 16b collapses the bag and allows its removal from the cast module.

Internal watertight bulkheads are included in the modules by preshaping the flexible bag with pairs of annular inwardly

extending rims 16c and 16d. These rims permit concrete to occupy annular voids communicating with the module-shaped void to form inwardly facing grooves. When such grooves are present, it becomes a relatively simple task to mold deck, see FIG. 4, sections cast on lightweight wooden forms.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described.

What I claim is:

1. An apparatus for constructing a unitized elongate concrete casting having an upper opening comprising:

means defining a removable external shell configured to define the external dimensions of a bottle-shaped cavity communicating with said upper opening;

means for providing an opposing surface being equal-distantly spaced from the inner wall of said external shell including;

a rigid elongate support member extending through said upper opening and coaxially disposed in said bottle-shaped cavity,

a flexible collapsible envelope configured to provide said opposing surface and have the dimensions to define the internal dimensions of said bottle-shaped cavity when flooded with a fluid, and

a plurality of sets of tie wires joining said flexible envelope to said support member ensuring the equal-distant spacing and internal dimensions of said bottle-shaped cavity, said sets being connected along said support member to orient the individual wires in a perpendicularly supporting attitude with respect to said envelope; and

means for fluidly flooding and evacuating said flexible envelope, upon flooding, forming a bottle-shaped cavity mold between the flexible envelope and said external shell for receiving poured concrete, upon the hardening thereof, permitting the evacuation of said flexible envelope to permit its collapse and the withdrawal of the providing means through said upper opening and the removal of said shell from said unitized elongate concrete casting.