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Guy et al.

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[45] **June 26, 1973**

[54] **PORTABLE RETAINING STRUCTURE**

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[52] **U.S. Cl.** **61/46.5**, 62/260

[51] **Int. Cl.** **E02d 21/00**

[58] **Field of Search** ..... 61/46, 46.5, 50, 61/34, 36 A, 1; 62/260

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[57] **ABSTRACT**

A portable marine structure for use as an artificial island and retaining support for fill material includes a tank member having a base member and a wall member sealed to the base member and capable of being flooded with water and sunk in a body of water with flood water to be replaced by select fill material, that may or may not be frozen to resist ice forces against the retaining structure. The floatable structure also includes an outer shell having an outer wall member spaced from and surrounding the tank wall member and a truss system connecting the tank wall member to the outer wall member. The outer shell is open at top and bottom. The artificial island structure is created by floating the marine structure to a desired water location, sinking the structure by flooding the tank with water and then anchoring the structure by filling the outer shell with fill material. When the structure is to be salvaged, it is floated by removing the fill material from the outer shell and removing water from the tank member.

12 Claims, 8 Drawing Figures

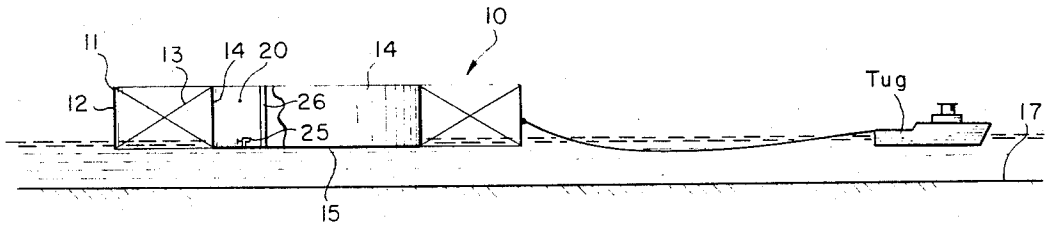
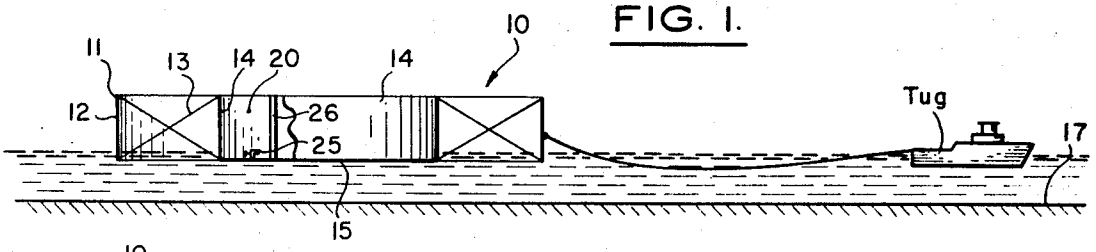


FIG. 1.



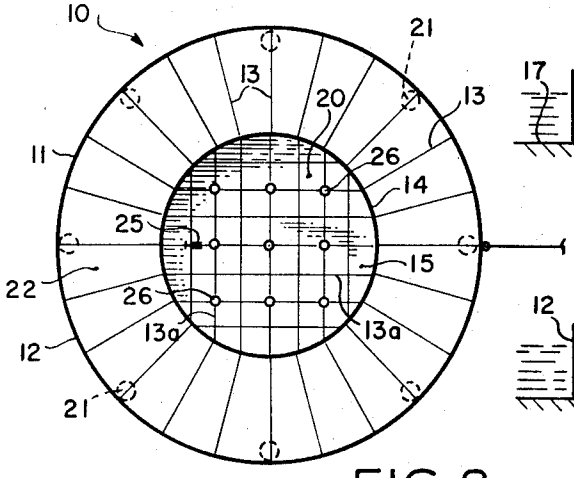


FIG. 2.

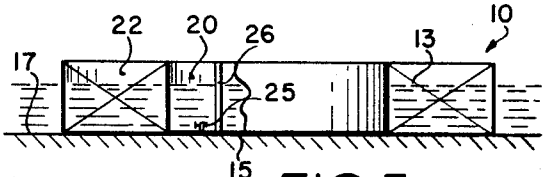


FIG. 3.

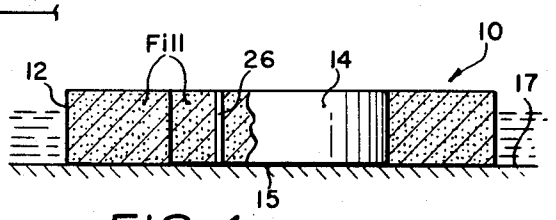


FIG. 4.

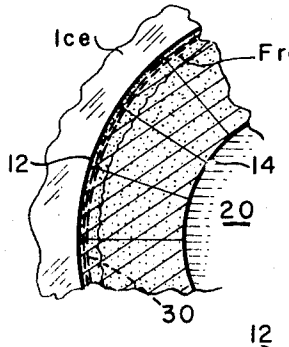
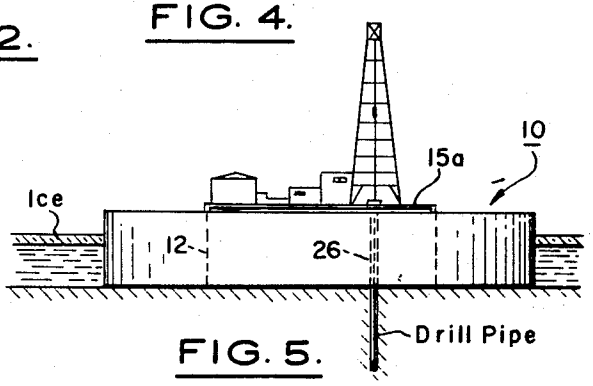


FIG. 6.



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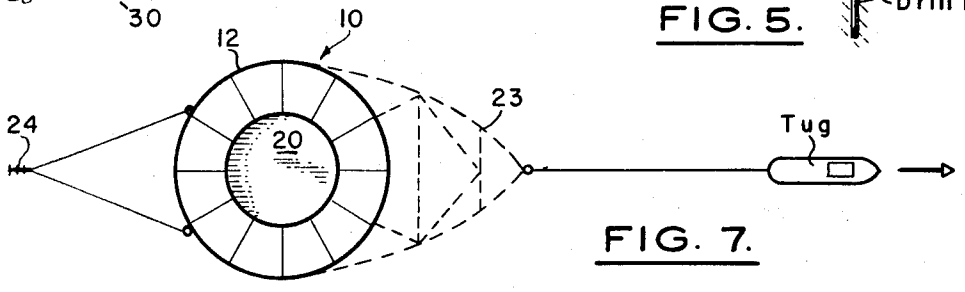

FIG. 7.

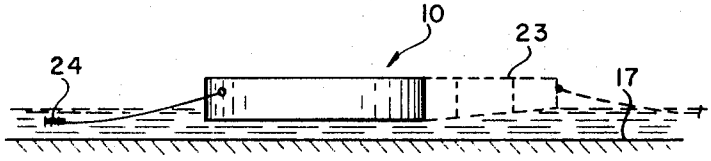

FIG. 8.

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PORTABLE RETAINING STRUCTURE

BACKGROUND OF THE INVENTION

The present invention concerns creating a portable, salvageable, artificial island structure for use in shallow water depths, preferably as an oil or gas well drilling and/or production platform. More particularly, the invention concerns a thin wall marine structure capable of being floated to a desired water location, sunk at that location to form an artificial island and then later raised and salvaged.

Although artificial island fills using conventional sheet pile enclosures have been used for a number of years for near shore oil and/or gas drilling and production facilities, no portable retaining artificial wall island structures have heretofore been constructed or proposed. The marine structure of the present invention reduces fabrication, installation and salvage costs to a minimum. It is particularly useful in oil or gas exploratory operations because as an offshore drilling platform structure it is readily salvageable and movable to new locations.

SUMMARY OF THE INVENTION

Briefly, the invention comprises a portable, floatable barge structure capable of providing a retaining wall for select fill material and of, forming an artificial island which includes a tank member capable of being flooded with liquid and sunk in a body of water and having a base member and a wall member sealed to the base member; and an outer shell connected to the tank member comprising an outer wall member spaced from and surrounding the tank wall member and a truss system connecting the tank wall member to the outer wall member to provide support for the retaining wall during tow member.

The invention also encompasses a method for creating and salvaging an artificial island structure in which the structure is set at desired locations in water and removed therefrom.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view showing the marine structure of the invention under tow;

FIG. 2 is a top view of the marine structure shown in FIG. 1;

FIG. 3 is a side view of the marine structure of FIG. 1 showing it sunk on water bottom;

FIG. 4 is another side view of the marine structure of FIG. 1 showing it position on water bottom with the outer shell and tank member loaded with removable fill material;

FIG. 5 is still another side view of the marine structure of FIG. 1 positioned on water bottom illustrating use of the structure in drilling operations;

FIG. 6 is a top view of a portion of the outer shell of the marine structure of FIG. 1 illustrating freezing of fill material contained in the outer shell; and

FIGS. 7 and 8 are, respectively, top and side views of the marine structure of FIG. 1 illustrating a modified towing operation.

DETAILED DESCRIPTION OF THE INVENTION

As seen in FIGS. 1 and 2 a buoyant-type marine barge structure, generally designated **10**, is formed by a large diameter inner tank **20** having a vertically extending wall section **14** and a horizontally extending base member **15** sealed to the bottom of wall section **14**. Although tank **20** is shown as cylindrical for purposes of illustration, it may be square or rectangular or of whatever geometric configuration is required for stability of tow and/or ease in assembly and positioning. An outer, vertically extending wall section **12** of a desired geometric configuration which normally would be circular in design, as shown, is connected by means of a truss system **13** to the inner wall section **14** to form an outer shell designated **11**. Tank **20** may also be provided with structural support members such as grid work designated **13***a*. A top or deck **15***a* (see FIG. **5**) may be provided to cover at least a portion of the top area surrounded by wall section **14**.

The barge structure is made in a conventional manner. It may be constructed either by welding individual sheets together to form the circular or ring sections or it may be constructed from rolled sheets which are unrolled and assembled at the construction site. The truss system **13** may be formed by standard construction beams. Water depth, local bottom conditions, and the available draft to any desired location determines the overall size, geometric configuration, and buoyancy requirements for the tank **20**. The total vertical height for wall members **12** and **14** is that needed for total water depth which may include an ice-forming area (for arctic waters) plus necessary freeboard height. The relative dimensions of the inner (tank) and outer shells are dependent on the type of fill material used. Development of a full passive resistance to the expected overloading or surcharge is desired. The walls **12** and **14** must be spaced sufficiently to achieve independent loading from ice and surcharge (overloading) in order to develop the full strength of the barge structure installation. The primary purpose of the outer shell **11** is to provide a retaining wall for the fill material placed inside the outer shell. When in sunken position and adequately anchored with fill material, the structure should provide adequate resistance from sliding at the base when subjected to ice loads. The circular shape is preferred in artic waters to increase the strength level of the barge structure against crushing by ice. The overall dimensions of the outer shell should be adequate to provide a retaining wall for the mass required to resist sliding and overturning forces imposed on the barge structure by wave forces or by ice forces and, if needed, to provide adequate working space for drilling and production operations on top of the structure.

Truss system **13** supports the barge structure during towing and setting operations. It also provides additional support required to resist ice forces on the barge structure.

As an example of the dimensions for the barge structure that might be required in arctic waters, the outer wall **12** might have a diameter of 300 feet and inner wall **14** might have a diameter of 140 feet. The over-all height of each wall may be 35 feet where the water level **16**, above the water floor **17**, is 14 feet, the layer of ice is 6 feet and the freeboard height is 15 feet. As previously mentioned, inner tank **20** is sized to provide buoyancy needed to transport the barge structure **10**. However, to provide stability during towing and setting operations, additional buoyancy-tank volume, indicated by dotted lines **21**, may be provided in the space **22** between the two vertical walls **12** and **14**.

The base or bottom section **15** of tank **20** is provided with means such as sea cocks **25** to permit flooding and

sinking of structure **10** once it has been towed to the desired location. A plurality of tubular conductor members **26** extend from base member **15** to the top of the tank to provide drill stem access to water floor **17** without penetrating base member **15.**

Tank **20** is capable of accommodating various proposed uses of the structure. If it is desired to use tank **20** for dry storage, hydrocarbon storage, or for other purposes, then the truss system within tank **20** would be designed to accommodate these loads. When tank **20** is to be used as a support for drilling loads, then it might be filled with select fill materials as illustrated in FIG. **4.** The entire structure may be towed as a single unit or in separate units that may be assembled on the location for the structure. Prior to towing the barge structure to a desired location a drilling rig and/or production equipment may be placed aboard tank **20.** The select material may be sand or coarse grained material as opposed to silt and fine clay.

In operation, barge structure **10** after fabrication is towed, as illustrated in FIG. **1,** to a desired water location. Once located at the desired site, tank **20** is flooded by means of sea cocks **25,** or the surrounding water might be pumped into tank **20,** and the structure sinks to water floor **17** as shown in FIG. **3.** The outer shell is then filled with the select fill material to the extent necessary. It may be leveled with the top of outer wall **12** as shown. As indicated in FIG. **4,** if desired, the liquid in tank **20** may also be displaced with fill material.

As shown in FIG. **6** a refrigeration system indicated at **30** may be installed in outer shell **11** to freeze the fill material adjacent to outer wall **12.** Freezing the fill material may be required if the structural capacity to resist ice forces is not provided by the fill material outer wall and the truss system. Moisture may be added to the film material where necessary to permit the freezing operation to occur.

When it is desired to move barge structure **10** from a particular location, the fill materials are removed. The fill material may be dispersed by means of water jets and then the water and fill material mixture pumped out by means of large pumps. The water in tank **20** is then pumped from the tank to make it again buoyant. The barge structure is floated in that manner and then towed to any other desired location. If the fill materials are relatively inaccessible in the area of the barge structure location, it is possible to recover the material in the same manner hydraulically dredged material is recovered by pumping the material directly into a barge and permitting water to flow off, leaving the fill materials to be reused.

As seen in FIGS. **7** and **8,** removable false work **23** may be added to provide better tow characteristics for barge structure **10** when the tow is to cover long distances and tow characteristics might present problems. Although not shown, additional false framework may be added aft, if desired. Also, a sea anchor **24** may be attached to the aft section to aid tow stability.

Changes and modifications may be made in the illustrative embodiments shown and described herein without departing from the scope of the invention as defined in the appended claims.

Having fully described the nature, objects, method, apparatus and advantages of our invention, we claim:

1. A marine barge structure capable of providing a thin retaining wall for fill material comprising:

a floatable tank capable of being flooded and sunk in a body of water and having a base member and a wall member sealed to said base member; and

an outer shell connected to said tank comprising a thin outer wall member spaced from and surrounding said tank wall member and truss work means connecting said tank wall member to said outer wall member;

the space between said outer wall member and said tank wall member being open at the top and bottom.

2. A structure as recited in claim **1** including said tank having dimensions sufficient to provide adequate buoyancy to float said structure.

3. A structure as recited in claim **1** including piping extending through said base member for flooding said tank to cause sinking of said structure.

4. A structure as recited in claim **1** including refrigeration means arranged in said outer shell for freezing fill material when said fill material is located in said outer shell.

5. A structure as recited in claim **4,** in which said tank is of cylindrical shape.

6. A method for creating a portable retaining structure comprising:

a floatable tank capable of being flooded and sunk in a body of water and having a base member and a wall member, and an outer shell connected to said tank comprising a substantially vertical outer thin wall member spaced from and surrounding said tank wall member and connected to said tank wall member by framework comprising the steps of:

positioning said structure in a body of water;

flooding said tank to sink said structure to water bottom; and

adding fill material to said outer shell to anchor said structure on water bottom.

7. A method as recited in claim **6,** including the step of towing said structure to said position in said body of water to provide adequate structural strength to reduce ice crushing forces in arctic waters.

8. A method as recited in claim **7** including freezing at least a portion of said full material after said structure has been sunk to water bottom.

9. A method as recited in claim **8** including displacing said liquid in the tank with fill material after said tank has been flooded and sunk to water bottom.

10. A method for creating a portable retaining structure and artificial island and removing same using a structure which comprises a floatable tank capable of being flooded and sunk in a body of water having a base member and a wall member and an outer shell connected to said tank comprising a substantially vertical outer thin wall member spaced from and surrounding said tank wall member and connected to said tank wall member by truss work, the space between said outer wall member and said tank wall member being open at the top and bottom comprising the steps of:

flooding said tank to sink said structure to water bottom;

adding fill material to said outer shell to anchor said structure on water bottom;

removing said water from said tank to buoy said structure; and

removing said fill material from said outer shell.

11. A marine barge structure capable of providing a thin retaining wall for fill material comprising:

a buoyant floatable tank capable of being flooded and sunk in a body of water and having a base member and a wall member sealed to said base member;

an outer shell connected to said tank comprising a thin outer wall member spaced from and surrounding said tank wall member and truss work means connecting said tank wall member to said outer wall member;

the space between said outer wall member and said tank wall member being open at the top and bottom thereof;

additional buoyancy means located in said outer shell; and

said tank buoyancy and said additional buoyancy means being adequate to float said structure.

12. A marine barge structure capable of providing a thin retaining wall for fill material comprising:

a buoyant floatable tank capable of being flooded and sunk in a body of water and having a base member and a wall member sealed to said base member;

an outer shell connected to said tank comprising a thin outer wall member spaced from and surrounding said tank wall member and truss work means connecting said tank wall member to said outer wall member;

the space between said outer wall member and said tank wall member being open at the top and bottom thereof;

fill material located in said outer shell; and

refrigeration means arranged in said outer shell for freezing at least a portion of said fill material.

* * * * *