United States Patent

O'Neill

[15] 3,636,713

[45] Jan. 25, 1972

[54] MARINE BLOCK

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[73] Assignee: **Gratten Marine Research Corporation,** Yonkers, N.Y.

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[52] **U.S. Cl.** **61/4**

[51] **Int. Cl.** **E02b 3/08,** E02b 3/14

[58] **Field of Search** 61/4, 3, 37; 52/608, 609

[56] **References Cited**

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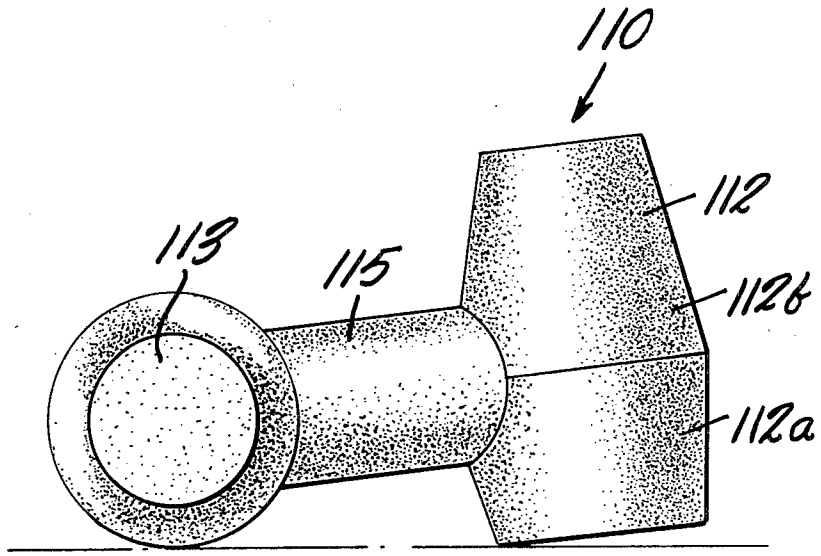
Primary Examiner—Jacob Shapiro

Attorney—Robert E. Burns and Emmanuel J. Lobato

[57] **ABSTRACT**

A marine block useable with other similar marine blocks in constructing marine structures such as groins, breakwaters, seawalls and seawall armor. The blocks are used in constructing structures in an arranged condition in which they are keyed together and may be disposed in a random arrangement. Each block is constructed as two massive, end cylinders of circular cross section joined together integrally by a center cylinder of lesser mass and diameter than the end cylinders. The end cylinders are arranged at 90° to each other so that one constitutes a horizontal cylinder and the other a vertical or upstanding cylinder.

12 Claims, 12 Drawing Figures



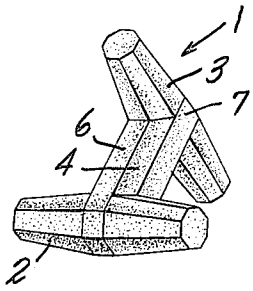


FIG. 1
(PRIOR ART)

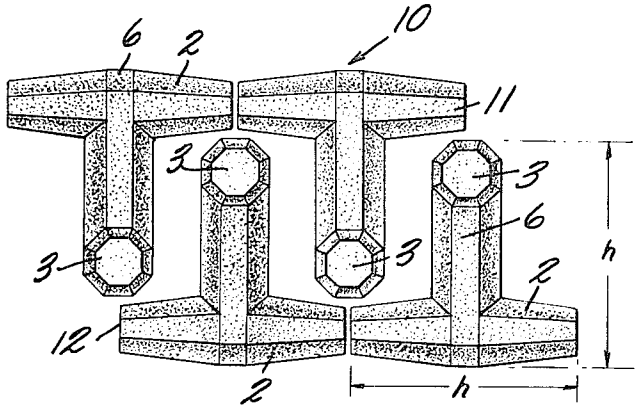


FIG. 2
(PRIOR ART)

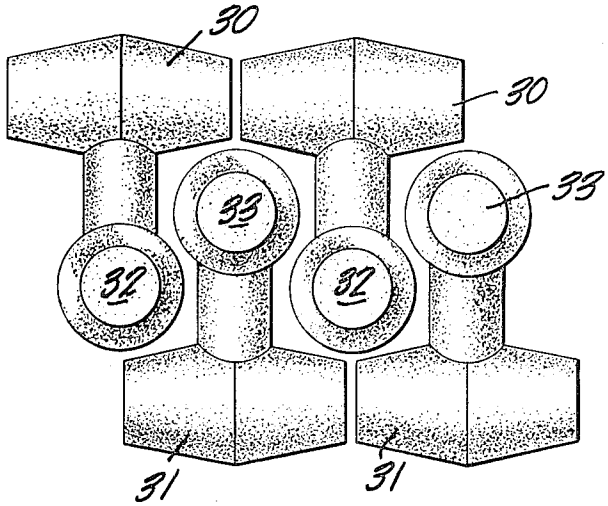


FIG. 6

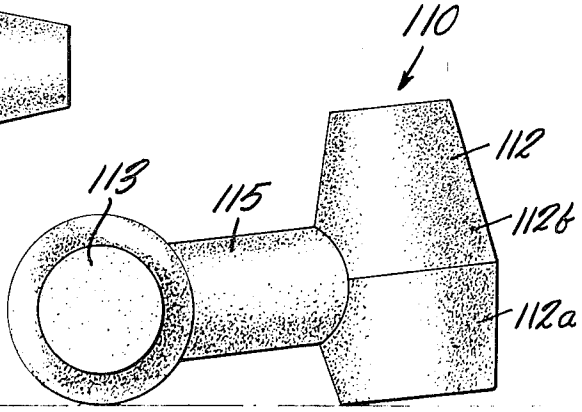


FIG. 12

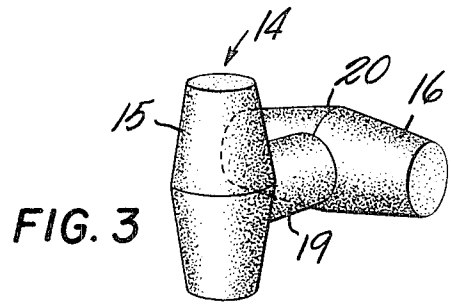


FIG. 3

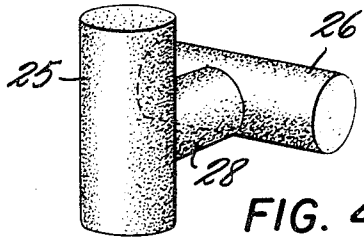


FIG. 4

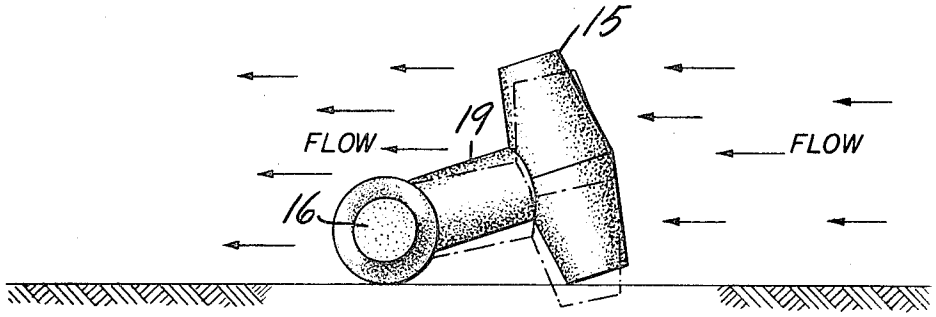


FIG. 5

FIG. 7

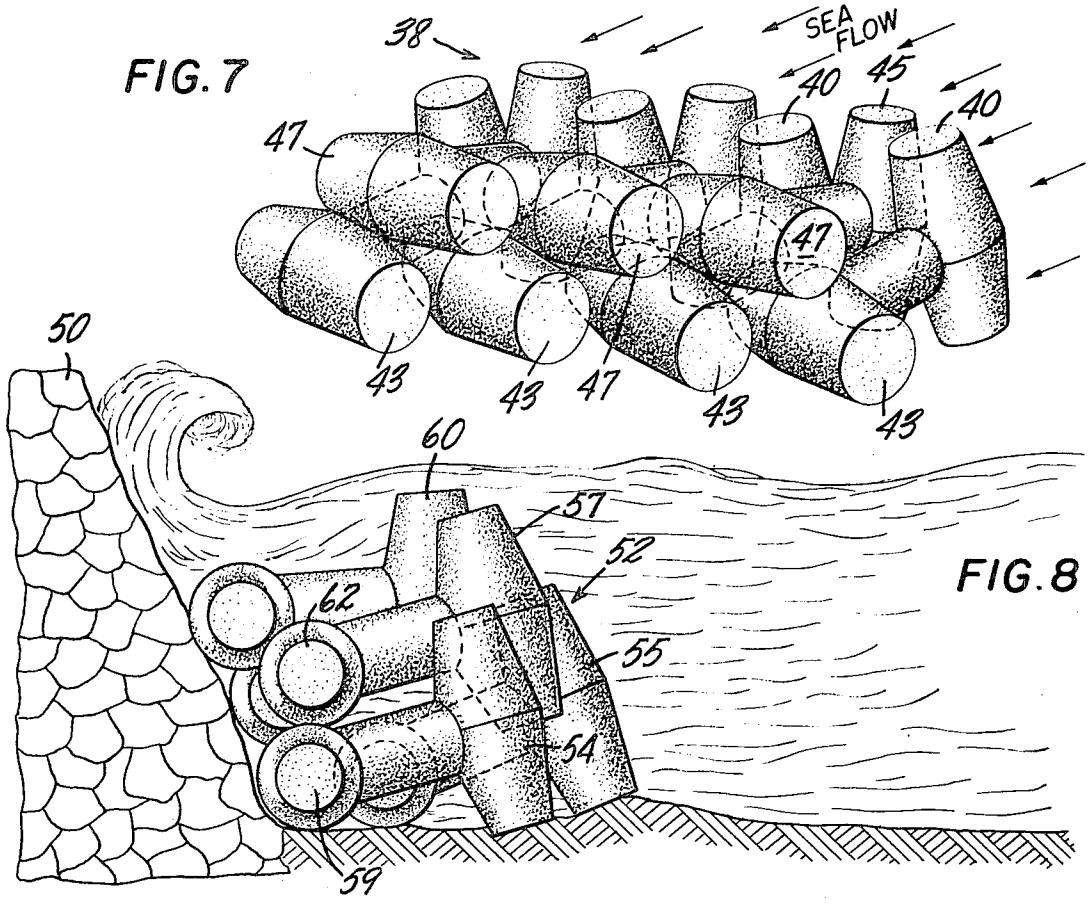


FIG. 8

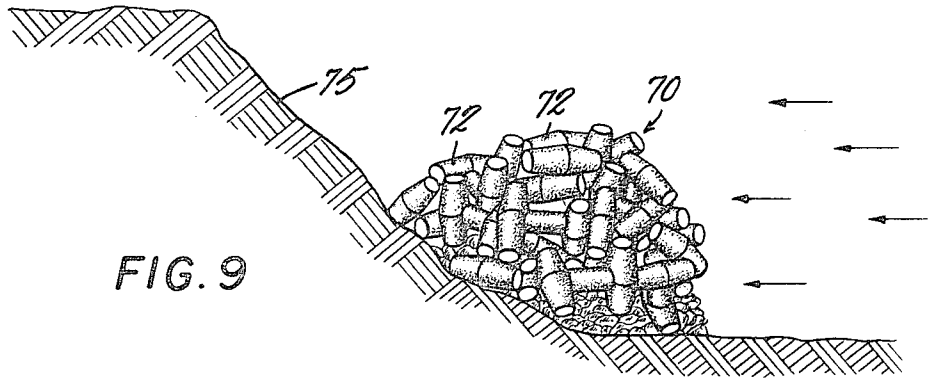


FIG. 9

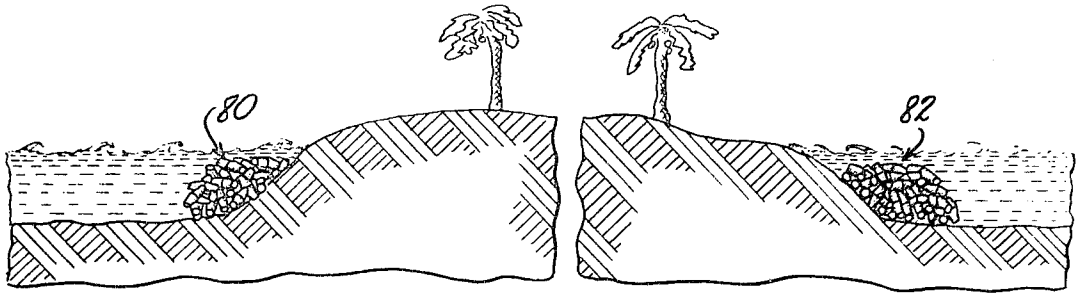


FIG. 10

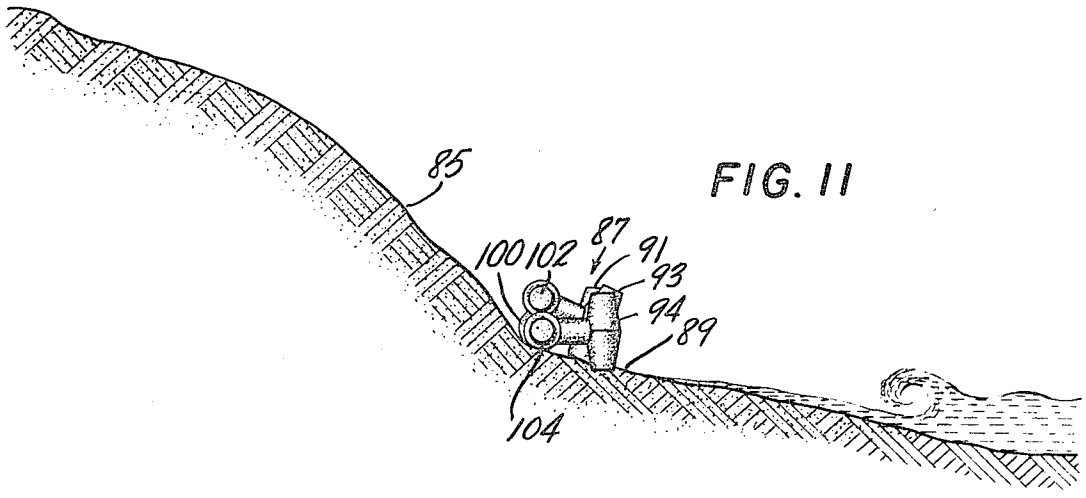


FIG. 11

MARINE BLOCK

This invention relates generally to marine structures and more particularly to a new and improved marine block for constructing marine structures such as seawalls, groins, breakwaters and seawall armor and the like.

The protection of breakwaters and seawalls and other sea works by means of concrete armor of various shapes is now common practice. The use of concrete marine blocks for constructing protection and erosion control structures is known. These known marine blocks are constructed so that the structures build with them have a high void-solid ratio and good porosity to avoid their destruction in a heavy sea.

The use of rectangular blocks and rip rap in constructing marine structures or as armor protection has certain problems in that in storms these blocks are washed away resulting in having to rebuild such marine structures.

Since these blocks and stones do not interlock they are washed away and lost in a storm. Because of this ocean engineers have sought to develop units which can be easily produced and placed to interlock in situ to form a larger unit mass having an adequate void-to-solid ratio. One of these known blocks is a block known as "Dolos" (Dolosse, plural) invented in South Africa and later herein described. The "-Dolosse" have proven successful in use for protecting seabanks and have been used to construct breakwater armor protection. The "Dolosse" while having excellent characteristics have serious limitations. The individual blocks will not interlock in situ as well as one might desire and their stability leaves something to be desired.

It is a principal object of the present invention to provide an improved marine block easily produced by casting or molding and having excellent interlocking ability in situ.

Another object is to provide an improved marine block making use of wedging principles and a new construction to greatly improve the block's stability.

According to the invention the marine block is constructed with two end cylinders, of circular cross section, in fixed, spaced relationship integrally joined by a center cylinder. The end cylinders are massive and have a much greater mass than the center cylinder which has a lesser diameter than the end cylinders. The end cylinders are arranged so that when one is in a horizontal position the other is an upstanding position. The axial dimensions of the end cylinders are less than the total of the length of the center or connecting cylinder plus the diameters of the two end cylinders in the areas of jointure of the connecting cylinder to the end cylinder.

Other features and advantages of the marine block and marine structures in accordance with the present invention will be better understood as described in the following specification and appended claims, in conjunction with the following drawings in which:

FIG. 1, is a perspective view of a marine block according to the prior art;

FIG. 2, is a plan view of a plurality of blocks of the type illustrated in FIG. 1;

FIG. 3, is a perspective view of one embodiment of a marine block according to the invention;

FIG. 4, is a perspective view of a second embodiment of a marine block according to the invention;

FIG. 5, is a side elevation view of a marine block of the type illustrated in FIG. 3;

FIG. 6 is a plan view of a marine erosion control structure constructed with marine blocks according to the invention;

FIG. 7, is a perspective view of a marine structure constructed with blocks according to the invention;

FIG. 8, is a side elevation view of a seawall armor protection according to the invention;

FIG. 9, is a side elevation view of a dune protection structure illustrating the use of marine blocks of the invention arranged at random;

FIG. 10, is a side elevation view of an arrangement for protecting a shore by an underwater structure;

FIG. 11, is a side elevation view of a marine structure according to the invention for protecting a dune; and

FIG. 12, is a side elevation view of a third embodiment of a marine block according to the invention.

A known marine block 1 is illustrated in FIG. 1. This block has two light end cylinders 2, 3 with a heave center or connecting leg or cylinder 4. The center cylinder is thicker than the end cylinders. The cross section of all the cylinders is prismatic so that flat surfaces 6, 7 and others, not shown, are formed by the end and center cylinders. The end cylinders have their longitudinal axis at 90° to each other so that one can be thought of as a horizontal cylinder 2 and the other as a vertical or upstanding cylinder 3.

The marine blocks or unit 1 may be arranged with other blocks of the same kind to form an erosion control structure 10 in which it can be seen that the units 1 are arranged in two lines 11, 12 and there is no interlocking between the blocks within a respective line nor between the two lines of units. The units of one line can be removed without interferring with the other line. These known blocks do, however, lock when deposited at random or pellmell.

Marine blocks according to the present invention are illustrated in the drawing, for example, FIG. 3—5 inclusive. A marine block 14 according to he invention is constructed with two end cylinders 15, 16. The end cylinders are massive, rigid, elongated body portions spaced from each other and held in a fixed spaced relationship by a center or connecting cylinder 19 which is of lesser diameter than the major diameter of the end cylinders in the area in which it is integrally connected thereto. This is in contrast to the known blocks in which the center cylinder 4 is the massive portion of the marine block and the end cylinders 2, 3 are light.

The marine block 14 is constructed with the longitudinal axes of the end cylinders 15, 16 disposed in planes substantially normal to each other and the longitudinal axis of one of the cylinders, for example the horizontal cylinder 16, is in the same plane as the longitudinal axis of the connecting cylinder 19. The end cylinders are dimensioned so that they have a lesser axial length than the overall transverse dimension of the marine block including the axial length of the center cylinder 19 and the major diameters of the two end cylinders. This is in contrast to the known blocks where the dimension labeled *h* are the same. For example, in a marine block according to the invention if a marine block is of the 2-ton type an equal weight known block will have end cylinders that have an axial length of the end cylinders of 6 feet while in the case of the present invention the cylinders are only 4 feet, 6 inches long.

In the known blocks the sides of the center or connecting cylinder are disposed coplanar with the midportion of the end cylinders since the center cylinder is the massive portion of the block. In the present invention the thinner center arm 19 is of such a diameter that the end cylinders have a very large angular surface, for example the surface designated 20, that is free of the connecting cylinder 19 so that there is less ability of the cylinder to skid or slide and it has greater stability than the known blocks. The reduction in the possibility of skidding becomes quite important when blocks according to the invention are placed on an incline, for example on a dune as later explained.

The cylinder of the type illustrated in FIG. 1 is shown in FIG. 5 in position in use. In this instance the cylinder 16 is disposed as a horizontal cylinder and the upstanding or vertical cylinder 15 is disposed upstream toward the flow. The end cylinders are two frustoconical portions joined at the base. A seaway flowing from right to left as illustrated in FIG. 5 will cause the block to embed itself as illustrated in broken lines. It will be noted that the horizontal cylinder 16 will tend to avoid any scouring downstream of the block when the flow direction reverses as during backflow. For example, if a series of blocks according to the invention are set in a row the erosion control structure will be such that the blocks preclude scouring upon flow in an opposite direction.

A second type or embodiment of the marine block of the invention is illustrated in FIG. 4 in which end cylinders 25, 26 are connected by a connecting or center cylinder 28. In this instance the cylinders are not tapered as in the embodiment il-

lustrated in FIG. 3. The circular cylinders function similarly to the embodiment of FIG. 3.

The blocks according to the invention have excellent interlocking characteristics as illustrated in FIG. 6. As disclosed in this figure a plurality of blocks 30, 31 are arranged so that the horizontal cylinders are aligned in two separate lines with the upstanding associated end cylinders 32, 33 in a staggered configuration. The upstanding cylinders fit into spaces defined between the horizontal cylinders, the connecting cylinders and next adjacent upstanding cylinders so that interlocking takes place. In this kind of an arrangement the upstanding cylinders will define voids that allow a flow of water, parallel to the plane of the drawing sheet, to dissipate its energy and the backflow will deposit any particles of solid materials that it is carrying. The horizontal cylinders preclude scouring forwardly or rearwardly of the upstanding cylinders 32, 33 so that the arrangement lends itself to constructing a beach erosion structure.

An erosion control structure 38 is illustrated in FIG. 7 in which a plurality of blocks are arranged with end cylinders 40 facing the direction of the flow of the sea and horizontal cylinders 43 arranged in staggered relationship. The horizontal cylinders 43 form a row and other blocks are arranged so that the upstanding cylinders 45 are disposed between the next adjacent cylinders so that the horizontal cylinders 47 overlie the lower row of horizontal cylinders 43 as illustrated. This structure has the upstanding cylinders staggered somewhat in the manner of the structure in FIG. 6, however, the horizontal cylinders are all downstream of the upstanding cylinders, so that the elements or units are completely interlocked and the backflow is completely precluded from scouring behind the rows of upstanding cylinders.

The present invention can be used to construct a seawall protective armor. In FIG. 8 a seawall 50 is protected by a protective armor, 52 comprising a plurality of marine units according to the invention arranged in tiers. As illustrated in the drawing end cylinders 54, 55 of respective blocks have wedged therebetween a vertical or upright end cylinder 57 with the respective horizontal cylinders 59, 62 overlying each other. The third row or tier of blocks has the upstanding cylinders 60 thereof wedged between the upstanding end cylinders 57 of the second tier so that a very strong interlocked structure is constructed that has voids of sufficient dimension to allow the water flow therethrough so that the energy of an incoming flow is dissipated on the protective armor without excessive impacting as is the case where a solid and completely impervious face is presented to the water flow.

While the structures heretofore described have had the marine blocks thereof systematically arranged in an interlocking relationship the units of the present invention can be used to construct seawalls, jetties and the like by having the blocks distributed within the structure at random. In order to form such structures the blocks are deposited pellmell. Such structures are illustrated in FIGS. 9 and 10.

As illustrated in the drawings a dune-protective structure 70 has a plurality of blocks 72 arranged pellmell to protect a shore dune 75 from erosion. The structure, as before described, provides a porous arrangement dissipating the forces of an inflow as water and the backwash will be reduced in velocity so that any solid materials being carried thereby are deposited and scouring is precluded so that actually the dune 75 is built up behind the structure 70, that is to say on the land side or inboard direction relative to the protective structure 70. A similar arrangement is illustrated in FIG. 10 in which two structures 80, 82 protect opposite sides of an island to preclude erosion.

An erosion control structure somewhat similar to the arrangement illustrated in FIG. 7 is illustrated in FIG. 11 for precluding beach erosion. As illustrated in the drawing a dune 85 is protected by an erosion control structure 87 at the foot of the dune and on the edge of a beach 89. The structure is constructed with a plurality of marine blocks with end cylinders 91, 93, 94 arranged upstanding and the horizontal cylinders 100, 102, 104 thereof stacked as illustrated interlocking the blocks so that a very strong structure is formed where in order for the sea to move one block it is necessary to move a very large portion of the structure.

The blocks heretofore described are constructed with the end cylinders having portions thereof symmetrically arranged with respect to the longitudinal axis of the connecting cylinder so that the longitudinal axis thereof is an axis of symmetry with respect to each individual end cylinder. As can be seen in FIG. 5 the center of gravity of each block is disposed in the connecting cylinder and is relatively low and considerably lower than the known blocks illustrated in FIG. 1. In order to improve the stability of the blocks according to the invention by lowering the center of gravity of the individual blocks a third embodiment of blocks can be constructed in which one section of the vertical cylinder is of lesser axial length than the other section and is of greater cross section diameter. Such an embodiment is illustrated in FIG. 12 in which a block 110 has a vertical cylinder 112 and a horizontal cylinder 93 connected with a connecting or center cylinder 115. A bottom section 112*a* of the vertical cylinder 112 has a shorter axial length than an upper section 112*b*. The blocks of this third embodiment are arrangeable in structures of the type heretofore described. The lower or bottom section 112*a* increases the stability of the block by lowering the center of gravity of the unit. Moreover, in the illustration of this embodiment the taper of the bottom section has been reduced so that the diameter or width of the lower section is increased, along the axial length, as compared to the upper section. However, it will be understood that this need to be accomplished only in one cylinder. The symmetry of the masses of the end cylinders can be maintained relative to the center of gravity by the increase in thickness of the bottom section proportionately to the reduction in axial length thereof.

It can be seen from the construction of the block according to the invention that the use of massive end cylinders avoids moments of rotation around the center of gravity. This increases the stability of the blocks and allows the use, in conjunction with the reduced center of gravity on relatively steep slopes for dune protection. The stability of this construction is thus greatly enhanced.

While preferred embodiments of the invention have been shown and described it will be understood that many modifications and changes can be made within the true spirit and scope of the invention.

I claim:

1. A marine block useable with other similar marine blocks in constructing marine structures such as groins, breakwaters, seawall armor and the like, the marine block comprising, two, massive, rigid, end cylinders disposed with their longitudinal axes at about 90° to each other, a center cylinder having its ends integrally joined to the end cylinders intermediate the opposite ends of each cylinder thereby holding the end cylinders spaced and fixed relative to each other, the center cylinder having a diameter smaller than the diameter of each end cylinder in the areas of juncture to the end cylinders, and said center cylinder having less mass than either of the end cylinders.

2. A marine block useable with other similar marine blocks in constructing marine structures such as groins, breakwaters, seawall armor and the like according to claim 1, in which the end cylinders each comprise two frustums of cones with the bases of the frustums joined together, and in which each of the end cylinders has a circular cross section.

3. A marine block useable with other similar marine blocks in constructing marine structures such as groins, breakwaters, seawall armor and the like according to claim 1, in which each cylinder has a circular cross section.

4. A marine block useable with other similar marine blocks in constructing marine structures such as groins, breakwaters, seawall armor and the like according to claim 1, in which the center cylinder has a longitudinal axis intersecting each of the end cylinders in the areas of juncture centrally between the opposite ends of said end cylinders.

5. A marine structure comprising, a plurality of marine blocks, each marine block comprising two massive, rigid end cylinders disposed spaced from each other in fixed relative positions, a rigid center cylinder integrally connecting the two end cylinders rigidly to each other holding the end cylinders in fixed relative positions disposed on opposite ends of the center cylinder and with the longitudinal axes of the two end cylinders disposed in plane normal to each other, the center cylinder having a lesser cross section dimension along the axial length thereof than either end cylinder, the center cylinder having less mass than either end cylinder, and the blocks being arranged so that the structure previous to water.

6. A marine structure according to claim 5, in which each marine cylinder is alike in configuration.

7. A marine structure according to claim 5, in which the marine blocks each have one of said two end cylinders disposed substantially upstanding.

8. A maine structure according to claim 5, in which the marine blocks each have one of said two end cylinders disposed at an angle relative to a horizontal plane.

9. A marine structure according to claim 5, in which said blocks are arranged superposed on each other at random.

10. A marine structure according to claim 4, in which said blocks are arranged with one cylinder thereof upstanding and the upstanding end cylinders in a row.

11. A marine block useable with other similar marine blocks in constructing marine structures such as groins, breakwaters, seawall armor and the like, the marine block comprising, two massive, rigid end cylinders disposed with their longitudinal axes at about 90° to each other, a center cylinder having its ends integrally joined to the end cylinders intermediate the opposite ends of each cylinder thereby holding the end cylinders spaced and fixed relative to each other, the center cylinder having a longitudinal axis intersecting one of end cylinders in an area closer to one end of said end cylinders than the opposite end thereof, the center cylinder having a diameter smaller than the diameter of each end cylinder in the areas of juncture to the end cylinders, and said center cylinder having less mass than either of the end cylinders.

12. A marine block useable with other similar marine blocks in constructing marine structures such as groins, breakwaters, seawall armor and the like according to claim 11, in which the end cylinders each comprise two frustums of cones with the bases of the frustums integrally joined together, and in which each of the end cylinders has a circular cross section.

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