United States Patent

Hard

[15] **3,691,774**

[45] **Sept. 19, 1972**

[54] TRANSPORTABLE BREAKWATER

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[21] Appl. No.: **24,748**

[52] **U.S. Cl.** .....**61/5,** 61/1 F

[51] **Int. Cl.** **E02b 3/06**

[58] **Field of Search**.....61/5, 4, 3, 1

[56] **References Cited**

UNITED STATES PATENTS

310,551	1/1885	Averell	61/4
2,185,458	1/1940	Giliasso	61/5

FOREIGN PATENTS OR APPLICATIONS

2,671	1868	Great Britain	61/5

Primary Examiner—Jacob Shapiro

Attorney—Charles K. Wright, Jr., William G. Gapcynski and Lawrence A. Neureither

[57] **ABSTRACT**

The invention relates to a transportable breakwater comprising a plurality of floating units, each unit having a horizontal fin-like protrusion which rotates to a vertical position for intercepting waves when the unit is tipped leeward by wave action. Mooring blocks placed in tandem and the connecting chains permit the floating units to yield gradually to oncoming waves.

4 Claims, 4 Drawing Figures

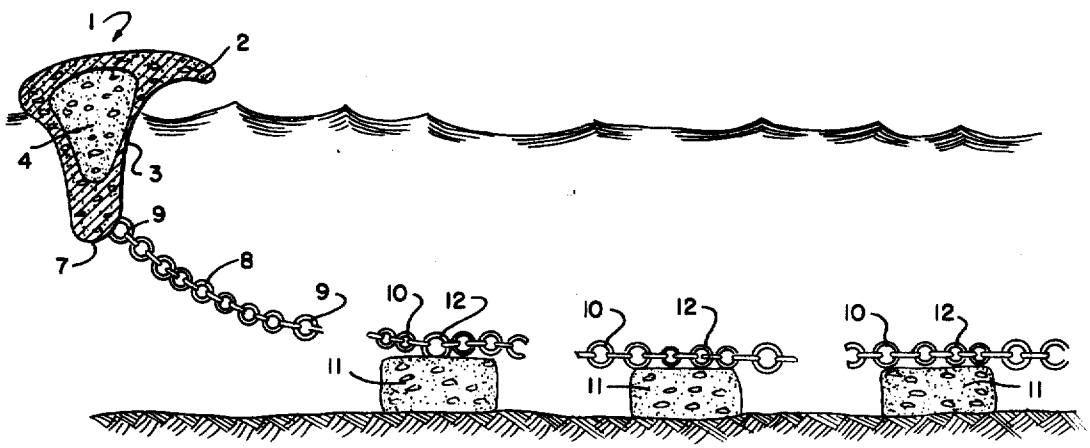


FIG. 4

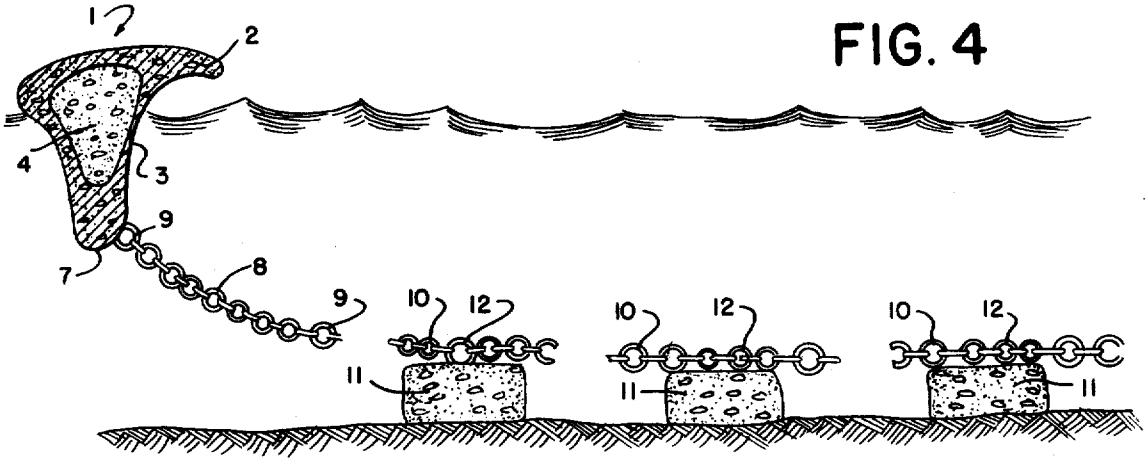
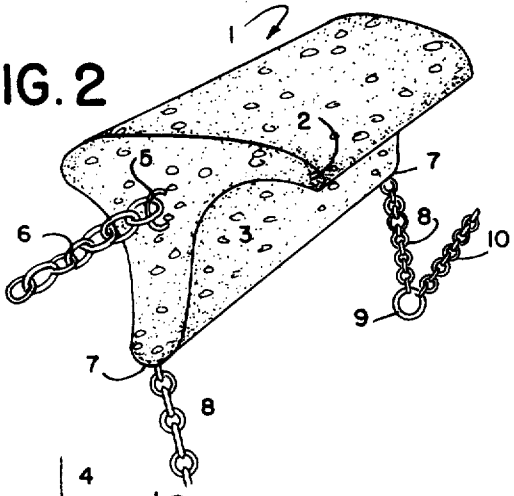


FIG. 2



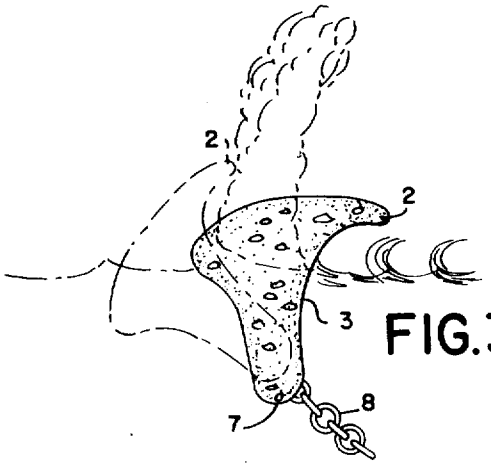


FIG. 3

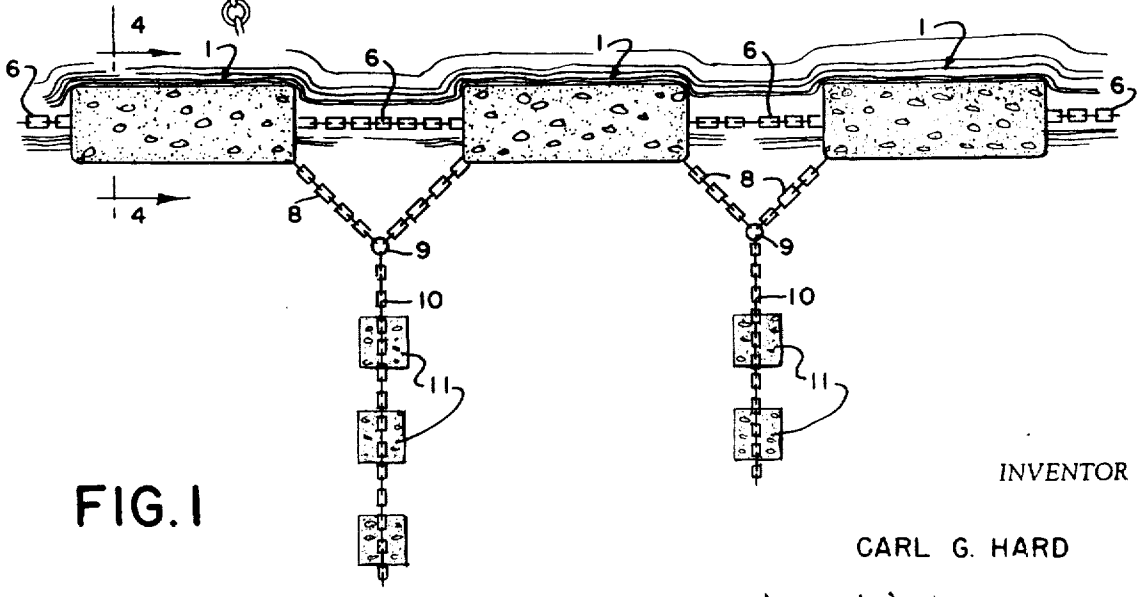


FIG. 1

INVENTOR

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BY Charles K Wright Jr

ATTORNEY

TRANSPORTABLE BREAKWATER

The invention described herein may be manufactured and used by or for the Government without the payment to me of any royalty thereon.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is used for damping waves and has utility in protected area of water such as in harbors, near beaches, and around construction projects.

2. Description of the Prior Art

Although breakwaters have long been used, the most effective ones have been large, bulky devices which do not lend themselves to a change in location and reuse. U.S. Pat. No. 919,788 discloses a device of this type which makes use of concave slopes. U.S. Pat. No. 817,904 discloses another bulky type having long frames which are tilted toward the sea when the water is calm. When struck by a wave the frames shift toward land gradually breaking the force of the wave.

U.S. Pat. No. 310,551 illustrates the most common type of breakwater which is easily transportable. It consists of floating blocks which are connected by chains to various anchorage arrangements. The blocks float partly submerged, their effectiveness partly limited by their small size and partly by the manner in which they are anchored. Even though a plurality of mooring blocks may be used, when they are arranged in a line parallel to the line of the floating units, a large wave striking the floating units will cause the mooring blocks to be either quickly uprooted and the entire system shifted, or the floating units will be passed over with a negligible damping effect on the wave.

SUMMARY OF THE INVENTION

The present invention is a breakwater having a plurality of interconnected floating units of a unique design anchored by mooring blocks placed in a tandem arrangement. The most significant features are the design of the floating units whereby a fin-like protrusion on each unit is forced into a vertical position as the unit is tipped by wave action thereby creating a large wave-deflecting surface and the use of mooring blocks arranged in a tandem manner to gradually absorb the total drag of the wave forces.

It is an object of the present invention to provide a breakwater which causes maximum damping of waves with a compact, inexpensive system.

It is a further object of the invention to provide a breakwater in which the units may be constructed of concrete or ferro-cement.

It is a still further object to provide a structure which is easily towed into place and assembled by any vessel capable of handling mooring blocks.

It is another object to provide a breakwater whereby the height of wave protection is independent of the rise and fall of the tide.

Still another object of the invention is to provide a plurality of floating units designed so that their maximum height is used to intercept waves when the wave pressures are at their greatest.

It is a further object of the invention to provide a mooring system for the breakwater which eliminates a sudden yanking stress which would interfere with the constancy or stability of the wave-resisting fin-like protrusion and would cause the unit to fail.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the breakwater.

FIG. 2 is a perspective view of a floating unit.

FIG. 3 is a side view of a floating unit.

FIG. 4 is a cross-section of a single floating unit taken on the line 4—4 of FIG. 1 and a series of mooring blocks.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 4 depicts floating hull units 1, each unit having a fin-like protrusion 2, a concave slope 3, and a flotation void 4. The units 1 have securing means 5, whereby chains 6, are connected between units 1, as seen in FIG. 2. At the ballast end 7 of each of the units 1 a chain 8 is secured as shown in FIGS. 2 and 4. The other end of the chain 8 is secured to a yoke ring 9 as is the chain 8 from the nearest end of the next succeeding unit 1. Another section of chain 10 connects the yoke ring 9 with a plurality of mooring blocks 11 by connecting means 12. Between each of the succeeding hull units 1 a string of mooring blocks 11, as just described, is positioned perpendicular to the line of the hull units 1.

When protection from waves is sought the hull units 1, constructed of concrete or ferro-cement, are strung out as needed, the mooring blocks 11 being positioned on the side where the wave action originates. The hull units 1 float at least half submerged until wave forces cause the units 1 to be tipped leeward or away from the force. Tension in the chains 10 leading from the ballast sections 7 of the units 1 to the mooring system constrains the ballast sections 7 of the units 1 while the other ends of the units 1 are swept upward by the wave force. This causes the fin-like protrusions 2 to extend vertically and assist in damping the wave.

Each of the lines 10 of tandem mooring blocks 11 provide gradually increasing resistance, for as the waves strike the hull units 1 increments of chain 10 and block 11 weight come into play until the total weight is sufficient to have absorbed the total drag of the wave forces. The wave forces vector is balanced by the buoyancy vector of the units 1 while the fin-like protrusion 2, is held erect by the drag of the mooring lines 10. The harness arrangement 6 between floating units 1 is for self-balancing of the units 1 to insure proper orientation.

Tidal changes will not interfere with the breakwater when the length of the mooring line 10 is sufficient to permit the first of the series of mooring blocks 11 to lie on bottom when the floating hull units 1 are operational at high tide.

The tandem arrangement of the mooring blocks 11, permitting a gradual yielding of the system, increases the stability of the fin-like protrusions 2 of the hull units 1 once they have been forced into upright positions by the impact of the waves.

I claim:

1. An offshore breakwater comprising:

a. a plurality of buoyant units, each of said units having a substantially horizontal portion above the water surface and an integral depending ballast portion below the water surface, said horizontal portion having a protrusion projecting beyond said ballast portion into the direction of oncoming

waves, said depending portion having diverging generally concave opposed surfaces coextensive with said horizontal portion;

b. means flexibly interconnecting said units;

c. an internal void in each of said buoyant units; and

d. anchoring means flexibly connected to the bottom of said depending ballast portion of each of said buoyant units to limit lateral movement of said buoyant units during wave action and permit rotational movement of said substantially horizontal protrusion to a vertical position upon impact by wave action.

2. An off-shore breakwater as recited in claim 1 wherein said anchoring means comprises a plurality of groups of tandemly connected, submerged mooring blocks, each group of tandemly connected blocks aligned in a direction perpendicular to the alignment of said buoyant units whereby wave action produces gradual movement of said blocks in the direction of said wave action.

3. An off-shore breakwater as recited in claim 2 wherein said anchoring means further comprises:

a. chains connecting said ballast portion of each of said buoyant units to a yoke ring positioned equidistantly between adjacent ends of said

buoyant units; and

b. a chain connecting each of said groups of tandemly connected mooring blocks to a yoke ring.

4. A buoyant unit comprising:

a. a mass having a base portion with an outwardly curved surface and an upstanding portion integral with said base portion;

b. an internal void in said mass;

c. said upstanding portion having a pair of bounding surfaces joined at one edge and diverging from said edge in opposed generally concave configurations and at an opposite edge joining said base portion;

d. a first one of said concave surfaces having a larger radius of curvature than the opposing surface; and

e. an elongated projection formed by the juncture of said base portion and said upstanding portion and bounded on one side by the curved surface of said base portion and on the opposite side by the concave surface having the greater radius of curvature, wherein said elongated projection protrudes horizontally above a water surface when said buoyant unit is floated in water.

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