Dec. 14, 1926. 1,610,341

L. A. WELLS

CONCRETE BREAKWATER AND METHOD OF INSTALLING SAME

Filed Oct. 18, 1920 3 Sheets-Sheet 1

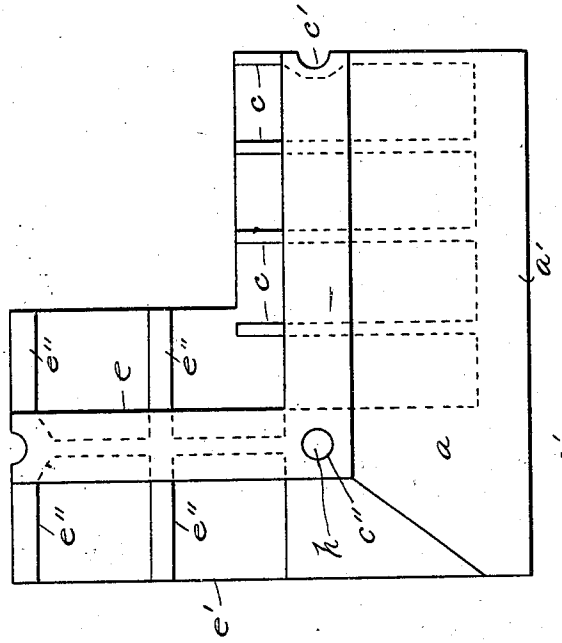


Fig. 2

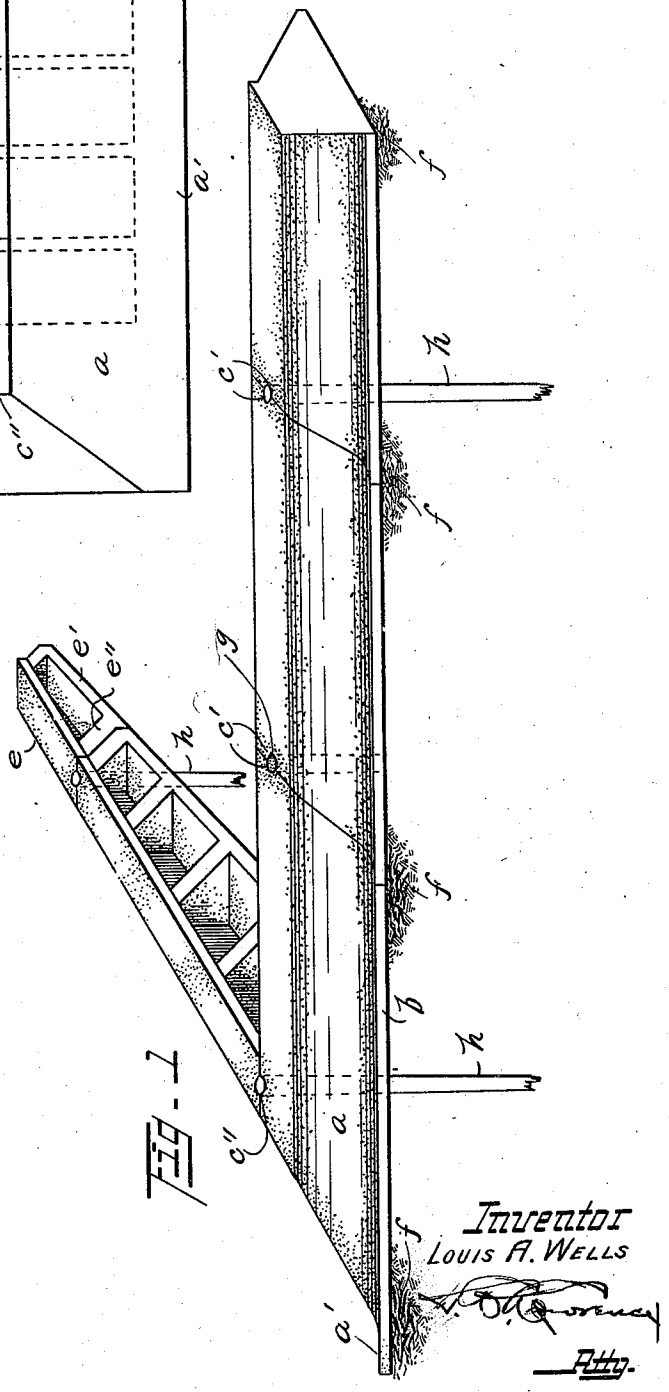


Fig. 1

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CONCRETE BREAKWATER AND METHOD OF INSTALLING SAME

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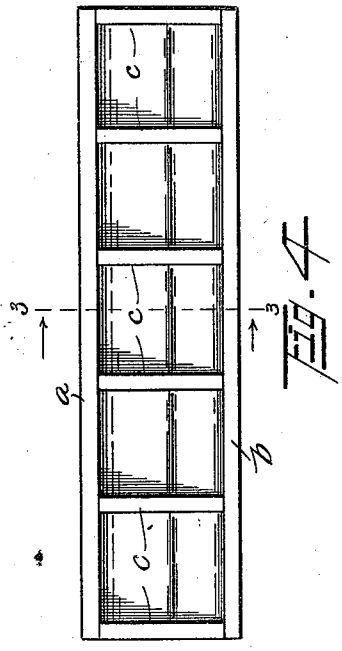


Fig. 4

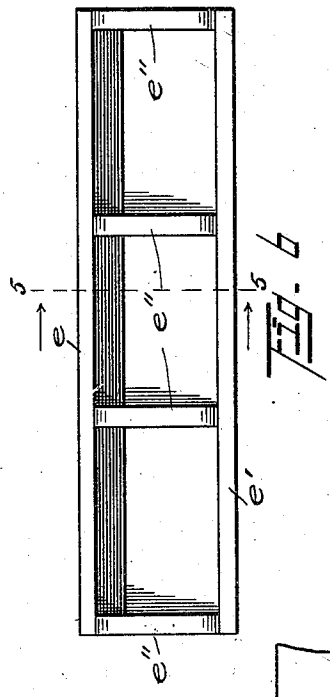


Fig. 6

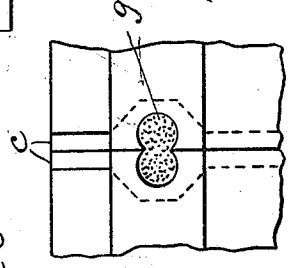


Fig. 7

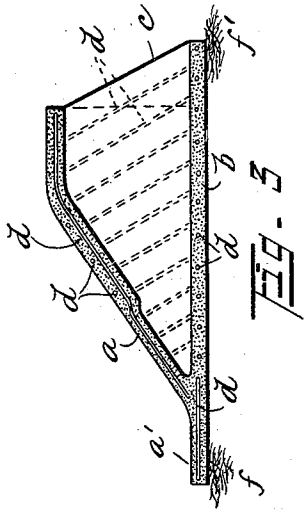


Fig. 3

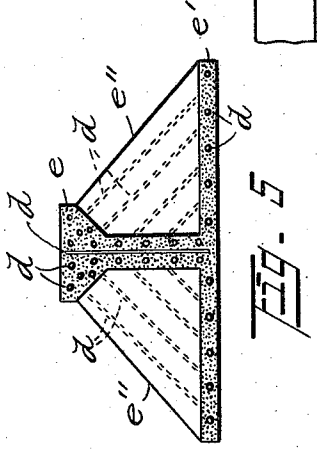


Fig. 5

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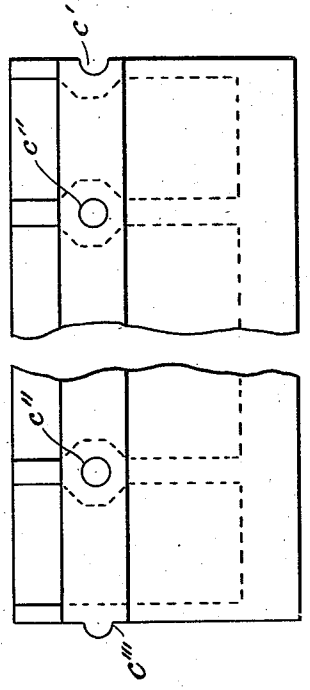


Fig. 9

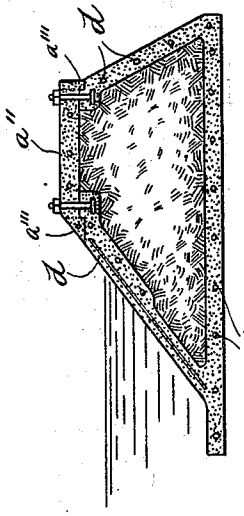


Fig. 10

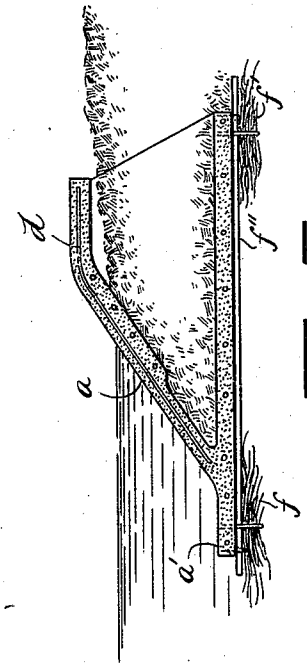


Fig. 8

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By

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Patented Dec. 14, 1926. 1,610,341

UNITED STATES PATENT OFFICE.

LOUIS A. WELLS, OF CLEVELAND, OHIO.

CONCRETE BREAKWATER AND METHOD OF INSTALLING SAME.

Application filed October 18, 1920. Serial No. 417,715.

My invention relates to improvements in concrete breakwater construction and method of installing and anchoring the same, and has for its object the provision of a type of reinforced breakwater adapted for sectional precasting, which may be fabricated and installed with a minimum of expense and much more expeditiously than obtains with any prior structure. Moreover, I have sought to provide a type of breakwater section which may be readily interlocked and anchored, and in addition is made self-anchoring by the action of the waves.

My improved method contemplates generally the precasting and seasoning of suitable, reinforced concrete sections of a type best adapted for the work in hand and preferably rendered capable of interlocking or keying together, preparing a suitable footing, placing the sections and uniting them, as by driving interposed piles for initial anchorage, or interlocking or keying the sections together.

The preferred type of section is provided with an inclined front facing the water and partially submerged, and with an extended base and lateral buttresses affording a spacious, hollow interior of trough shape, closed at the ends and fully open from the rear adapted to be filled with sand or gravel through the washing of the waves. This natural action affords the cheapest mode for firmly securing the breakwater in position, so that the initial anchorage, as by driving interposed keying piles, may frequently be dispensed with in many situations requiring a protecting breakwater.

The features of my invention and certain embodiments thereof may best be explained in connection with the accompanying drawings, wherein:

Figure 1 is a perspective view of a corner section of breakwater incorporating my improvements;

Fig. 2 is a plan view of a precast concrete corner;

Fig. 3 is a transverse sectional view of a precast intermediate member;

Fig. 4 is a rear view of said member;

Fig. 5 is a transverse section of the buttressed wall member;

Fig. 6 is an elevation thereof;

Fig. 7 is a fragment illustrating a mode of keying;

Fig. 8 is a transverse sectional view showing the member of Figs. 3 and 4 when anchored by the sand, together with attaching poles and mats;

Fig. 9 is a plan view of a modified member of self-keying or interlocking type, and

Fig. 10 is a transverse sectional view of a modified reinforced concrete section adapted for a rock footing.

Throughout the several figures of the drawings I have employed the same character of reference to designate similar parts or members.

The hollow, reinforced concrete section comprises a sloping front *a* conforming generally to the sea-face contour well known in breakwater construction but generally of lower inclination and preferably having a toe or extension *a'* integral with the base *b* which is laterally connected with the floor by buttresses *c*. These buttresses may be duplicated intermediately of the ends of the section as required by the particular location in which the section is to be used and the length in which it is precast. Reinforcing members *d* are indicated throughout the several portions of the structure, which will be disposed as shown and along the other lines indicated by engineering practice.

It will be observed that the preferred proportions of the section shown dispose the base and its extension both rearwardly and in front of the sloping front face inclined at an angle of less than 45° while the end buttresses are provided with registering or alined semi-circular openings *c'*, whereby the sections may be keyed together and also anchored in place, if desired. Moreover, the section is completely closed at the ends and fully open from the rear approximately at the level of the footing or mat, while the base is rearwardly extended to catch the break of the waves over the apex; thereby forming a most effective trap for sand, gravel and débris.

The typical hollow section may be adapted to the needs of an end or corner construction, as shown in Fig. 2, a corner pile being provided for at *c''*, while the hollow section merges in a girder wall *e* having the integral base *e'* and the recessed buttresses *e''*. These typical reinforced concrete sections may be precast and preferably seasoned for a sufficient length of time to insure their maximum strength and efficiency.

Variants from the section shown in Fig. 3 are indicated in Figs. 9 and 10. In the former there is illustrated a precast section

open rearwardly, as previously described, but having complemental end interlocking means present in the vertical rib c''' and a groove or recess c' adapted to accommodate the adjacent rib c''' of the next section. Also, intermediate openings c'' are provided for non-keying piles to be driven therethrough for anchoring the section in position.

Where rock footings are available and the self-anchoring feature of wave-washed sand and gravel is not present, I preferably utilize the hollow precast section shown in Fig. 10. This has an open top through which the fill of sand, gravel and the like may be made artifically when the section is in position. A reinforced precast slab a'' is then bolted into place over one or more alined sections, thereby assisting in maintaining the breakwater intact, while closing the interior against the action of the water.

In order to afford adequate percolation for the water with sand and gravel footings, I have resort to brush mats suitably positioned with respect to the breakwater. If desired, such mats f and f' may be wired the length of each section upon supporting poles f'', should it be impracticable to position and weight the mats along the site of the breakwater in advance. Indeed, this practice not infrequently is preferred, since the mats are accurately positioned in setting each section and the work proceeds much more rapidly.

The procedure for constructing the breakwater from these precast sections rarely, if ever, requires the building of the customary coffer dam about the site. This, of itself, affords a most important and marked advantage in comparison with the well known method obtaining in breakwater construction. If necessary, the site is leveled off and front and rear sections of brush mat f, f', are provided upon which the concrete sections are positioned in alinement for the length of breakwater desired; end or corner sections preferably terminating the completed structure. All the sections are then or successively keyed together or interlocked in any suitable manner, as by the insertion of a concrete filler g within the openings c', or by driving piles h to the desired depth which not only serve to key the sections together, but also anchor them initially.

This breakwater may be rapidly constructed in ordinary weather from the seasoned, precast, concrete sections and the piles may be driven as fast as the work progresses, so that the waves or tide will not displace the breakwater or drive the sections out of alinement. Said sections, being hollow, naturally are much cheaper to construct than like masses of concrete or masonry could be built in position. However, this hollow structure admirably lends itself to anchorage by the wash of sand and gravel naturally accomplished by the action of the waves. In a very short time the base is covered and the hollow spaces between the buttresses will be filled with sand by the well known tendency of the waves to deposit the sand when their motion is arrested. The brush mats, preferably provided in most locations, will serve to permit the percolation of the water without washing away the footing of the breakwater. Consequently my improved structure very shortly is anchored by an accumulation of sand, gravel and débris within and behind the concrete structure and level with the upper portion of the sloping floor, as in Fig. 8.

From the foregoing, the essential features of construction and the procedure for installing the sectional, concrete breakwater will readily be understood by any engineer. It is scarcely necessary to explain that the details of construction may be varied to suit the needs of different locations in which breakwaters must be built. The mode of keying or interlocking these sections, quite obviously, may be varied, as by forming the interlocking portions as illustrated in Figs. 7 and 9. The order of procedure and the illustrations furnished are somewhat typical and diagrammatic in character, rather than fixed or invariable as to details, in order to explain the salient features of my invention.

Having now described the preferred form of my invention as embodied in the breakwater meeting certain specific requirements, and the method of installing the same, I claim as new and desire to secure by Letters Patent, together with such departures therefrom as may be achieved by engineering practice, the following:

1. The precast section of reinforced concrete for constructing breakwaters, comprising an extended base, lateral buttresses and an inclined front of less than 45° inclination rearwardly open above the base, whereby solid material may be filled in by wave action and retained to anchor the section in position, substantially as set forth.

2. The precast section for constructing breakwaters, comprising an integral extended base, lateral buttresses and an inclined front provided at the ends with terminal keyways all formed from reinforced concrete and fully open rearwardly to permit the fill of solid anchorage material, substantially as set forth.

3. A precast reinforced concrete section for the construction of breakwaters, comprising a widely extended fill-receiving base, a gradually inclined front rearwardly open to the base whereby solid material may be filled in for anchorage, and integral end members, substantially as set forth.

4. A hollow reinforced concrete section for the construction of breakwaters and the like, comprising a hollow front of easy inclination, a fill-receiving base extending beyond the inclined front and key receiving end portions associated with the hollow structure, substantially as set forth.

5. A precast reinforced concrete section for the construction of breakwaters, comprising an extended base slab, an inclined front face, a top, end walls and buttresses integrally formed intermediately of the base slab and open rearwardly at the level of the slab, whereby a trap is provided for the natural deposit of anchorage material interiorly of said section, substantially as set forth.

6. In combination with a plurality of precast breakwater sections disposed end to end; each section comprising a precast base slab, extending to the front and rear thereof, a gradually inclined front face, and end walls of integral reinforced concrete the sections being completely open rearwardly, of mats disposed beneath said sections, whereby wave-deposited material may be trapped and the water may seep away without impairing the footing, substantially as set forth.

7. A breakwater of the class described, comprising a front portion of precast concrete sections disposed parallel with the shore and a rectangular positioned portion rearwardly sustaining the front portion; the front sections comprising hollow trough-shaped members completely open toward the shore with front faces inclined from the water at less than a 45° angle, and mats disposed beneath said front sections, substantially as set forth.

8. The method of forming a breakwater which consists in positioning relatively heavy hollow sections, comprising a front slope and open sand-trapping hollows on the reverse side thereof, in such position along the shore with respect to the wave-action as to permit the waves to fill such hollows with solid material.

9. The method of forming a breakwater, which consists in positioning a percolator stratum with relatively heavy trough shaped sections thereon, comprising a gradual front slope and completely open sand-trapping hollows on the reverse side thereof, in such position along the shore with respect to the wave-action as to permit the waves to fill such hollows with solid material and seep away partially through the percolator stratum.

In testimony whereof I do now affix my signature.

LOUIS A. WELLS.