Nov. 21, 1967 L. E. LLOYD 3,353,361

BREAKWATER

Filed July 26, 1966 2 Sheets-Sheet 1

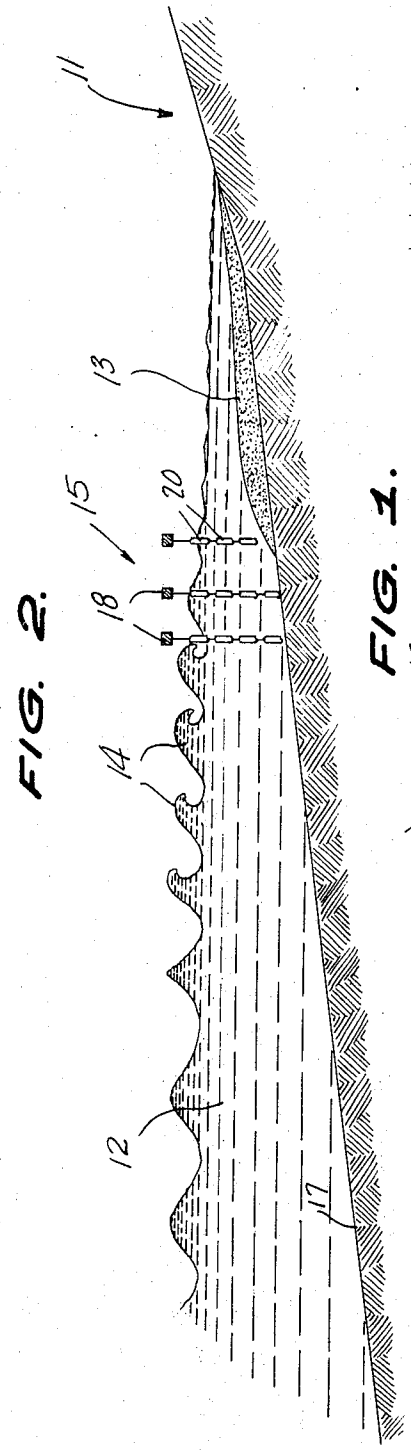


FIG. 2.

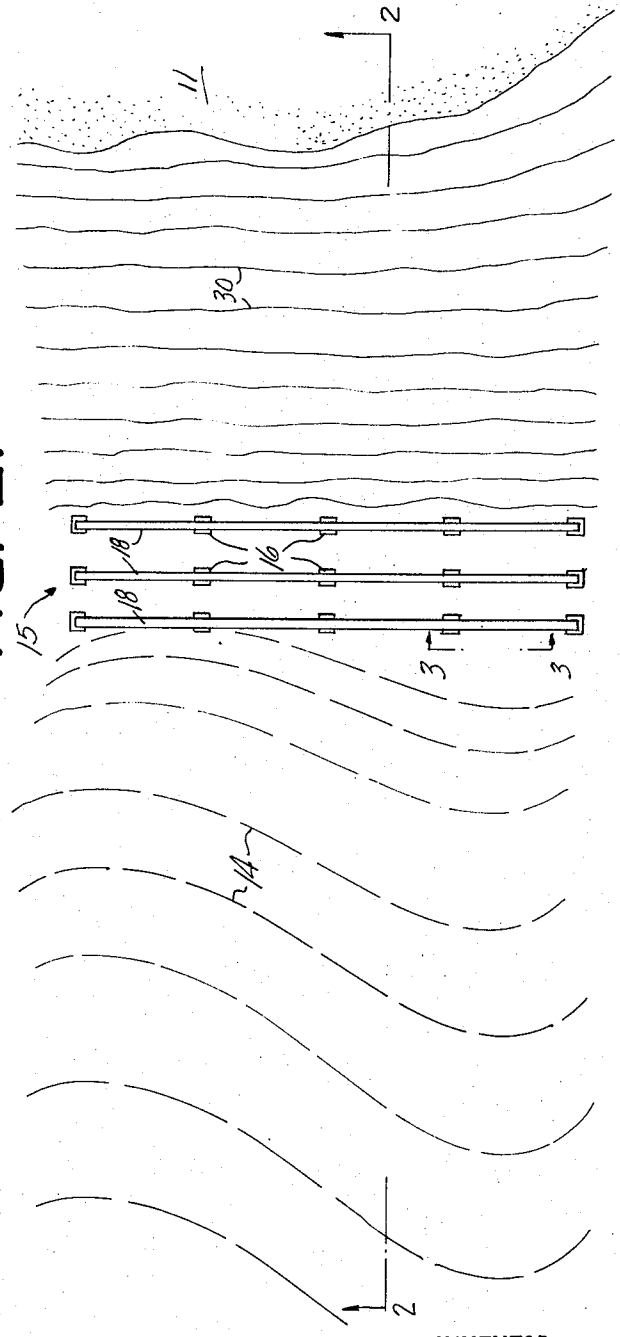


FIG. 1.

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FIG. 3.

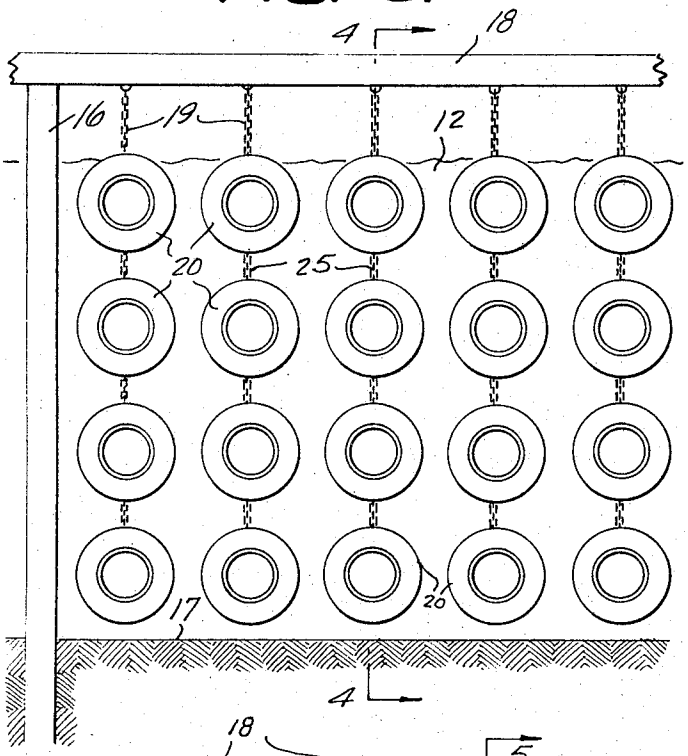


FIG. 5.

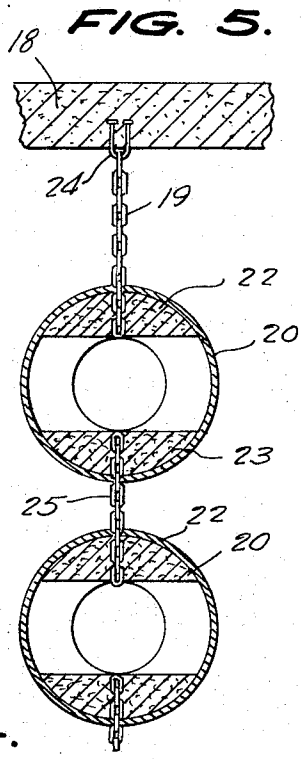


FIG. 4.

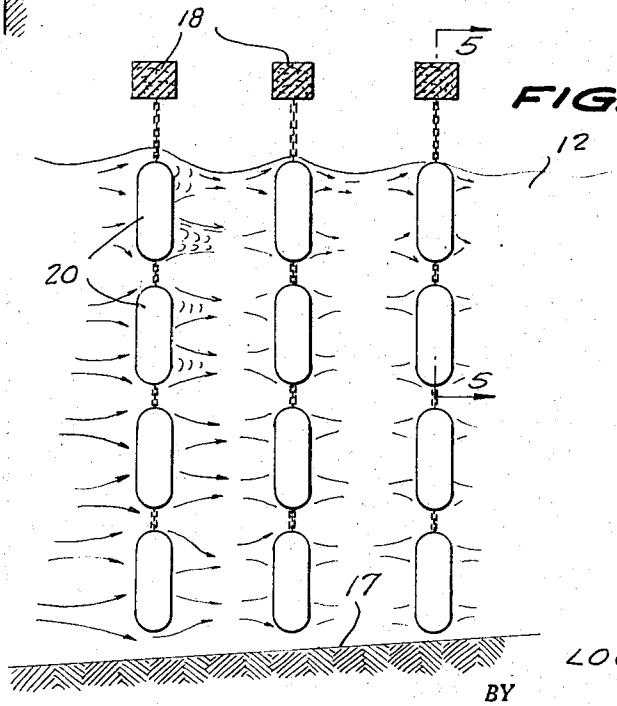
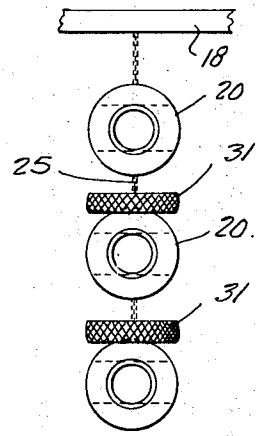


FIG. 6.



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BREAKWATER

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8 Claims. (Cl. 61—3)

This invention relates to the art of shore protection, and more particularly to method and apparatus for breaking up waves on shores and beaches for the purpose of preventing erosion and for conserving beaches as well as building up the deposit of sand and other material along beaches or shore lines.

A main object of the invention is to provide a novel and improved breakwater device as well as a novel and improved technique for breaking up wave action adjacent to a shore line or beach, the improved method and apparatus requiring the use of very simple physical components, said components being easy to obtain and being easy to install.

A further object of the invention is to provide an improved method and apparatus for retarding the action of waves adjacent to beaches or shore lines so as to prevent the breaking waves from washing upon and eroding adjacent beaches and for quieting the water in a manner which prevents the erosion of the shore line and which promotes the building up of the deposits of sand and other loose material carried by the water at the shore line or adjacent beach.

A still further object of the invention is to provide an improved breakwater structure for use adjacent a beach or shore line to break up or retard the movement of water waves and to thus prevent the moving water from washing away or eroding the shore line or adjacent beach, the structure employing simple and inexpensive components, being capable of being installed without requiring the use of expensive apparatus, being durable in construction, and being further capable of being installed without requiring the use of highly skilled labor.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawing, wherein:

FIGURE 1 is a top plan view showing a portion of a shore line provided with an improved breakwater structure constructed in accordance with the teachings of the present invention.

FIGURE 2 is a transverse vertical cross-sectional view taken substantially on the line 2—2 of FIGURE 1.

FIGURE 3 is an enlarged fragmentary cross-sectional view taken substantially on the line 3—3 of FIGURE 1.

FIGURE 4 is a cross-sectional view taken substantially on the line 4—4 of FIGURE 3.

FIGURE 5 is an enlarged fragmentary cross-sectional view taken substantially on the line 5—5 of FIGURE 4.

FIGURE 6 is a fragmentary portion of a view similar to FIGURE 3, but illustrating a modification of the present invention.

Referring to the drawing, 11 generally designates the shore line or beach adjacent a body of water 12, the shore line or beach including a mass of sand 13 which is relatively loose and which is the result of particles carried by the water 12, such deposit being the result of the slowing down of the movement of the water adjacent to the shore line. Ordinarily, without the provision of some type of breakwater or retarding means, the mass of sand 13 would be agitated by the action of the waves, and would be dispersed, preventing the accumulation of such sand and other loose material. In fact, without the provision of some type of breakwater or water-retarding means at the shore line, in many instances, the shore line is

eroded or washed away by the pounding action of the waves 14 at the surface of the water.

In accordance with the present invention, a breakwater structure, designated generally at 15, is employed adjacent to the shore line 11 and located substantially in the position illustrated in FIGURES 1 and 2. Thus, the breakwater structure 15 comprises a plurality of upstanding supports 16, which may be vertical posts, or the like, firmly embedded in and supported by the bed 17 of the body of water 12, as shown in FIGURE 3, the vertical supports 16 projecting above the surface of the water and being spaced substantially uniformly along lines substantially parallel to the shore line. A plurality of rows of vertical posts or supports 16 may be employed, for example, three such rows, as shown in FIGURES 1 and 2, the spacing between the rows being somewhat smaller than the spacing between adjacent vertical supports 16 of a given row.

Rigidly-secured on the top ends of the vertical supports 16 of the respective rows are horizontally-extending beams or supports 18, which are thus supported above the surface of the water and which extend parallel to each other and substantially parallel to the shore line, as shown in FIGURE 1. The vertical posts 16 and the horizontal supports 18 may be made of any suitable material, such as reinforced concrete, or the like.

Depending from and secured to each beam 18 are a series of flexible chains 19, spaced apart in the manner illustrated in FIGURE 3, and secured to each of the chains 19 are a series of sequential weighted toroidal breakwater elements 20 immersed below the surface of the water, the series of sequential toroidal elements 20 being in side-by-side relationship, as shown in FIGURE 3, and being spaced apart by relatively short distances so as to define a wave-retarding curtain. For the purposes of economy and for utilizing materials which would otherwise be discarded or of no value, the elements 20 comprise old automobile tires which are suitably weighted, for example, by being provided in their top and bottom portions with masses of concrete 22 and 23, as shown in FIGURE 5. Thus, as shown in FIGURE 5, the upper supporting chain 19 has its top end anchored in the lower portion of the associated supporting beam 18, for example, by means of a U-bolt 24 whose bight portion is exposed and supports the top link of the chain 19. The lower portion of the chain is engaged through the top wall of the uppermost automobile tire 20 in the manner shown in FIGURE 5, and the lower lengths of the chain 19 are embedded in the upper mass of concrete 22. The successive subjacent automobile tires 20 of the sequential series are connected together by additional lengths of chain 25, the upper portions of such additional lengths being embedded in the lower concrete masses 23 and the lower portions of the chain lengths 25 being embedded in the upper concrete masses 22 of the subjacent tires.

It will be seen from FIGURES 3, 4 and 5 that suspended, weighted toroidal elements 20 are arranged so that they have a substantial degree of ability to turn freely so that they can readily adjust themselves in accordance with the direction of flow of water through and past them, while having, at the same time, a tendency to return to alignment with the adjacent tires above and below because of the weight of the suspended elements 20. Thus, the curtain structures defined by the respective groups of depending series of toroidal elements 20 carried by the beams 18 provide a wave-retarding action which protects the adjacent beach or shore line 11 and which promotes the building up of the mass of sand or silt 13 along the beach, as above-described.

The breakwater structure above-described differs in many respects from other types of breakwaters previously

employed because the essential parts of the breakwater structure of the present invention are supported by beams above the water surface, whereas, in prior structures the breakwater elements have been supported and built up from the bottom **17**, creating more eddys and currents than would be created by the improved breakwater structure of the present invention. Furthermore, as will be seen from FIGURE 1, the relatively large waves **14** are dampened by the breakwater structure **15** so that the resultant water waves reaching the beach or shore line **11** have very small amplitude, as shown at **30**, as compared with the amplitudes of the waves **14**. The wave-dampening action is produced by the resistance of the toroidal elements **20** to the movement of the waves therepast, the toroidal elements **20** turning, twisting, and slicing back-and-forth across the wave fronts engaged thereby and thus acting to disrupt said wave-front patterns. The resultant attenuation of the wave amplitudes, particularly, since the waves must pass through a plurality of curtains or barriers, considerably quiets the water, producing the relatively small and gentle ripples **30** in the area between the breakwater structure **15** and the beach or shore line **11**. This acts to protect the beaches and shore lines employing the breakwater structure **15** against erosion, as well as promoting the deposit of sand or silt so as to build up the beach sand as the material collects in the masses represented by **13** in FIGURE 2, and described above.

It is further apparent that by employing discarded automobile tires, which are in plentiful supply and which are normally scrapped, the breakwater structure **15** may be economically built, since it is merely necessary to weight the discarded tires with the concrete masses **22** and **23** in the manner above-described, connecting them with chain lengths **25** and providing an upper supporting chain **19** for each series of weighted tires. Most of the work involved can be performed by relatively unskilled workmen.

If so desired, the beams **18** may be employed as supports for flooring or decking, so that a pier may be created which may be employed for fishing or for other recreational or commercial purposes. Since the breakwater structure employs relatively few posts or supports **16**, this type of breakwater attracts fish, due to the absence of heavy obstructions. Thus, by decking over the horizontally-extending beams **18**, a very satisfactory fishing pier may be constructed.

In the modification illustrated in FIGURE 6, additional old automobile tires, shown at **31**, are employed, surrounding the connection chain lengths **25** and resting on the subjacent weighted, vertically-depending tires **20**. The provision of the loosely-arranged additional, substantially horizontal tires **31** increases resistance of the curtain and further acts to attenuate and slow down the wave action.

While certain specific embodiments of an improved breakwater structure have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A breakwater comprising a plurality of upstanding supports resting on the bed of a body of water and projecting above the surface of the water, rigid horizontal support means secured on the top ends of said upstanding supports, spaced depending flexible members secured to said horizontal support means, and a series of sequentially depending weighted non-buoyant toroidal breakwater elements secured by the uppermost element thereof to each flexible member and with the lowermost element closely adjacent the bed of the body of water in free immersed suspension, each element of each of the series being disposed with the axis of its central opening extending horizontally and having an overall size and opening of the order of those of an automobile tire, said elements intermediate the uppermost and lowermost elements of each series being flexibly interconnected to the adjacent ones of the elements vertically above and below, said toroidal elements being suspended so that they have a substantial degree of ability to turn freely, and the series of sequential toroidal elements being in side-by-side relationship along the horizontal support means to define a wave-retarding curtain.

2. The breakwater of claim **1**, and wherein said flexible members comprise lengths of chain.

3. The breakwater of claim **2**, and wherein said toroidal elements comprise automobile tires.

4. The breakwater of claim **3**, and wherein the tires are provided with masses of concrete in their top and bottom portions to serve as weighting means.

5. The breakwater of claim **4**, and wherein the lengths of chain connected to the horizontal support means have their bottom ends embedded in the masses of concrete in the top portions of the uppermost tires, the successive tires therebelow being connected by additional lengths of chain with their opposite ends embedded in the masses of concrete in the top and bottom portions of said successive tires.

6. The breakwater of claim **5**, and additional automobile tires surrounding said additional lengths of chain and arranged substantially horizontally and resting on the subjacent depending tires.

7. The breakwater of claim **1**, and wherein there are a plurality of parallel rows of upstanding supports, and the horizontal support means comprises respective parallel horizontal beams secured on the tops ends of the parallel rows of upstanding supports and each of said beams support a plurality of said series of elements.

8. The breakwater of claim **7**, and wherein the rows of parallel supports are spaced apart by distances substantially smaller than the spacing between the upstanding supports of the respective rows.

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