Aug. 1, 1961 LE ROI E. HUTCHINGS 2,994,201

WAVE SHIELD

Filed April 25, 1957 2 Sheets-Sheet 1

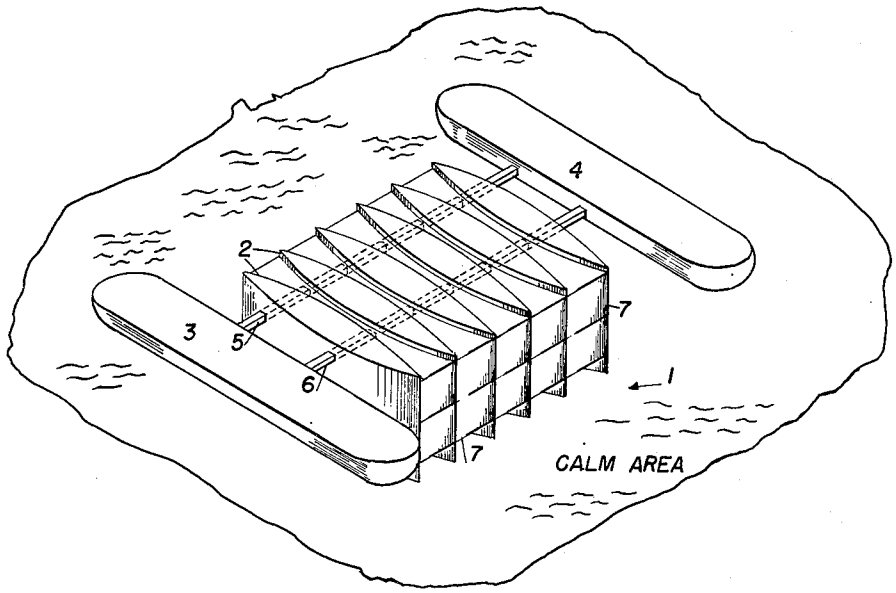


FIG. 1

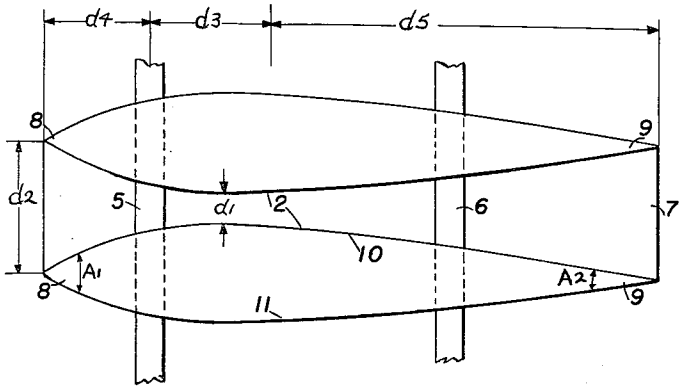


FIG. 4

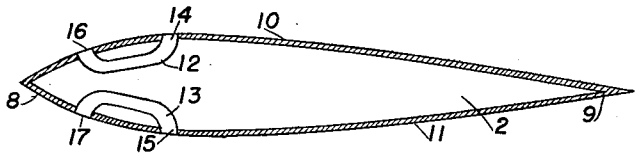


FIG. 6

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WAVE SHIELD

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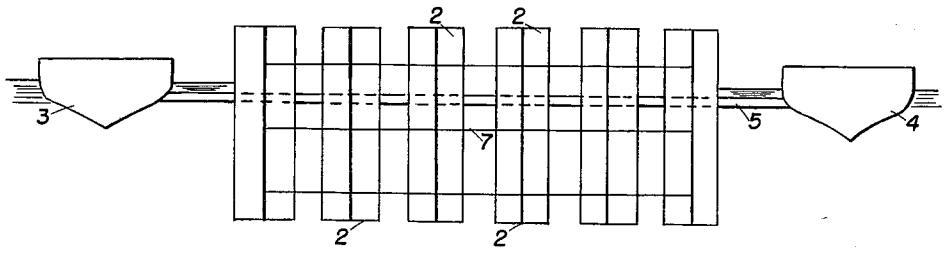


FIG. 3

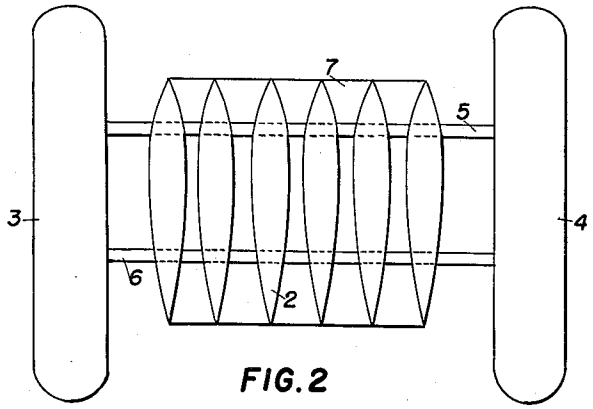


FIG. 2

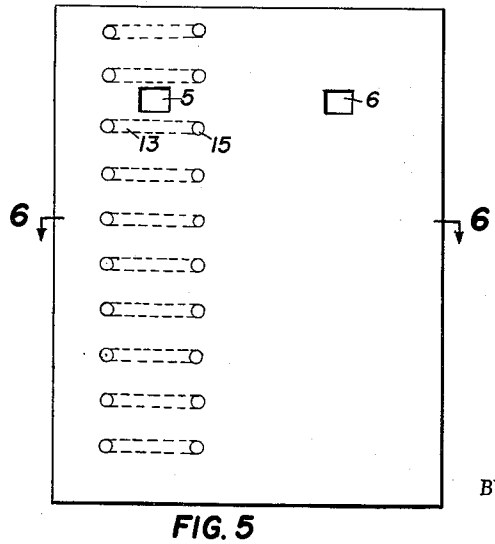


FIG. 5

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2,994,201

WAVE SHIELD

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Filed Apr. 25, 1957, Ser. No. 655,122
6 Claims. (Cl. 61—5)

This invention relates to new and useful improvements in wave-breaking devices and more particularly to a wave-breaking device which is operable to break waves into a series of interfering streams which emerge to form a calm area.

In many marine activities, such as the drilling of off-shore oil and gas wells, erection of stationary structures, cargo unloading and transfer, etc., work is often interrupted and serious physical damage done by rough seas or heavy swells. In the construction of some off-shore installations work has been retarded as much as 50% due to adverse weather conditions. It has become important, therefore, to develop some means to calm small areas of water to permit work within such an area, in spite of high waves and bad weather conditions.

In some locations where the water is relatively shallow it is possible to erect fixed physical barriers, such as breakwaters and the like, which protect limited areas from wave action. In deeper water it is not possible to use fixed barriers and some attempts have been made to use floating barriers of various types to protect against high waves. Floating wave barriers which have been used in the past have always been moved readily by the waves which they are intended to break and have not proved satisfactory for calming high waves sufficiently to permit off-shore work during adverse weather conditions.

It is therefore one object of this invention to provide an improved wave-breaking device which may be used in deep water to protect off-shore work.

Another object of this invention is to provide an improved wave-breaking device which may be floated on the surface of the water for calming an area of water to permit work to be carried out therein.

A feature of this invention is the provision of a wave-breaking device which includes a plurality of wave-breaking baffles which are shaped to provide passages of venturi-shaped cross-sections which are operable to calm waves passing therethrough.

Another feature of this invention is the provision of a wave-breaking device which floats on a plurality of elongated pontoons and which includes spaced baffles providing passages of venturi-shaped cross-section and extending above and below the calm water level by a distance at least as great as the crest-to-trough height of the waves.

Another feature of this invention is the provision of a wave-breaking device supported on a plurality of elongated pontoons and having baffles which are shaped to provide passages of venturi-shaped cross-section and having an arrangement of conduits for entraining air into water passing through the device at the throat of the venturi-shaped passages.

Other objects and features of this invention will become apparent from time to time throughout the specifications and claims as hereinafter related.

In the accompanying drawings, to be taken as part of this specification, there is clearly and fully illustrated a preferred embodiment of this invention, in which drawings,

FIG. 1 is a view of part of a body of water showing a wave-breaking device positioned therein to calm an area behind the device,

FIG. 2 is a plan view of the wave-breaking device of this invention showing the supporting pontoons and wave-breaking baffles,

FIG. 3 is a view in elevation showing the ends of the supporting pontoons of the wave-breaking baffles and showing horizontal plates which are positioned between the vertically extending baffles to further restrict the flow of waves through this device,

FIG. 4 is a detail plan view of two of the vertically extending wave-breaking baffles on a slightly enlarged scale relative to the other figures, and illustrating certain somewhat critical dimensions of the baffles,

FIG. 5 is a view in side elevation of one of the vertically extending wave-breaking baffles which shows the location of conduits within the baffles which are arranged to entrain air in the stream of water passing between adjacent baffles, and

FIG. 6 is a sectional view taken on the line 6—6 of FIG. 5 showing the construction of one of the wave-breaking baffles and the location of the air-entraining conduits therein.

This invention consists of a wave-breaking device which includes a plurality of wave-breaking baffles. The baffles are each provided with pointed front and rear ends and curved wall portions extending from the front to rear end. The baffles are positioned in alignment and laterally spaced so that they define a plurality of separate passages of venturi-shaped horizontal cross-section. The baffles are operable to break waves into a plurality of separate streams which emerge from the separate passages substantially free of wave motion. The wave-breaking device is preferably supported on two or more pontoons which are of sufficient length to provide stability in rough water. The wave-breaking baffles extend above and below the calm water level by a distance at least as great as the crest-to-trough height of the largest waves normally encountered.

Referring to the drawings by numerals of reference there is shown in FIG. 1 a portion of the surface of the water of a lake or seat which is very rough and has many high waves. Wave-breaking device **1** is located in this area and held in position by any suitable means, such as an anchor. The waves which pass through the wave-breaking device are substantially reduced in size and almost completely eliminated so that the area immediately behind the wave-breaking device is sufficiently calm to carry out any desired work such as the construction of oil or gas wells or other stationary structures.

The wave-breaking device consists of a plurality of vertically-extending wave-breaking baffles **2** which are supported on pontoons **3** and **4** by horizontally-extending supporting bars **5** and **6**. Pontoons **3** and **4** must be of sufficient length to avoid rocking of the device by the waves, and should therefore be at least twice as long as the crest-to-crest wave length of the largest waves to be broken by the device.

Wave-breaking baffles **2** are supported so that their upper ends extend above the calm water level by a distance at least ¾ the height from crest to trough of the largest waves to be broken. Baffles **2** extend below the calm water level a distance 1 to ½ times the crest-to-trough height of the largest waves to be broken. The device is also provided with a plurality of horizontally-extending walls or plates **7** which are vertically spaced and divide the space between individual baffles **2** into a plurality of vertically-spaced and horizontally-extending passages. These plates **7** are preferably spaced vertically from each other at a distance substantially equal to the distance between the pointed front ends of adjacent vertically-extended baffles **2**, and are substantially coextensive therewith.

Wave-breaking baffles **2** each have pointed front ends **8** and pointed rear ends **9** which are connected by curved

wall portions 10 and 11, respectively. The walls of pointed front end 8 of baffle 2 meet at an angle of 40°–60°. The angle of the walls of the rear pointed-end portion of baffle 2 is preferably equal to or less than 14°. The curvature of the walls of baffles 2 is such that the passages between adjacent baffles 2 is such that the passages between adjacent baffles are of a venturi-shaped horizontal cross-section.

The baffles are spaced so that the width d_1 of the throat of the venturi passage is from ¼ to ½ the lateral spacing d_2 between the front ends of adjacent baffles. The front end portions of the baffles have a length d_4 from ½ to ¾ the lateral spacing d_2 between the adjacent baffles. The curved central portion of the wall of the baffles adjacent to the venturi throat has a length d_3 which is ½ to 1 times the lateral spacing d_2. The trailing end-portion of the baffles, from the curved central portion back to pointed rear end 9, is of a length from 2 to 3 times the lateral spacing d_2 when the venturi throat width d_1 is ½ to ¼ d_2. The total length of the wave-breaking baffles is equal to $d_4+d_3+d_5$ which is a distance not less than the maximum crest-to-crest wave length of the largest waves to be broken.

The wave-breaking baffles may also be provided (as shown in FIGS. 5 and 6) with a plurality of conduits, 12 and 13, which extend from apertures 14 and 15, respectively, at the venturi throat, to apertures 16 and 17, respectively, at pointed leading end 8 of the baffles. Conduits 12 and 13 are positioned to entrain air and/or water from the forward end of the baffles and mix the same with the water passing through the venturi throat. This mixing action produces a considerable amount of froth and foam which further tends to calm the wave motion.

As is seen from the foregoing description, the size and proportions of this wave-breaking device must be varied according to specific situations in which the device is to be used. Thus, a larger device is required for the breaking and calming of large ocean waves than is required for the breaking and calming of the waves of an inland lake. If it is desired to calm an area of rough sea 100 feet wide, where the waves have crest-to-crest distances of 90 feet and crest-to-trough distances of 20 feet, the following dimensions are required for this wave-breaking device. The length of supporting pontoons 3 and 4 for this particular application is 270 feet. Six vertical venturi baffles 2 are supported on horizontal supporting bars 5 and 6 and have a height of 45 feet. The baffles are spaced 20 feet apart at their front and rear ends and provide a venturi throat which is 5 feet in width. The length of the leading end is 15 feet. The curved portion adjacent to the venturi throat is 20 feet long and the trailing end is 60 feet long. The overall length of the baffles is 95 feet for this particular installation. This wave-breaking device is anchored at the windward edge of the area to be protected, with the front ends of the baffles pointing into the oncoming waves. The waves which pass through the passages between venturi baffles 2 and horizontal plates 7 are broken up into a number of separate streams each of which interferes with the adjacent streams, and produces a relatively calm area to the rear of the device with the waves substantially reduced in height.

While there has been described only one preferred embodiment of this invention, it will be obvious to those skilled in the art that modifications of this invention can be made without departing from the scope of intended coverage of the invention as defined in the appended claims.

What is claimed as this invention is:

1. A wave-breaking device comprising a plurality of vertically-extending wave-breaking baffles of substantial height and length but very small in laterial width, means supporting said baffles in laterally spaced, aligned relation facing into the prevailing waves, said baffles being of such vertical dimension as to extend above and below the calm water line by a distance greater than the maximum height of the wave crests and depth of the wave troughs, respectively, each of said baffles having pointed front and rear ends and outwardly curved wall portions extending from the front to rear end with the baffles defining therebetween a plurality of separate passages of venturi-shaped horizontal cross-section with the width of the throat of the venturi being from one-fourth to one-half the distance between the front ends of adjacent baffles, a plurality of horizontally-extending flat plates extending between each of said vertically-extending baffles and substantially coextensively therewith, said flat plates being spaced vertically from each other at a distance substantially equal to the distance between the front pointed ends of adjacent vertically-extending baffles, said flat plates dividing said venturi-shaped passages into a plurality of separate vertically-spaced passages, and said baffles being adapted to break waves into a plurality of separate streams which emerge from the separate passages substantially reduced in height.

2. A wave-breaking device comprising a plurality of vertically-extending wave-breaking baffles, means supporting said baffles in laterally spaced, aligned relation facing into the prevailing waves, said baffles being of such vertical dimensions as to extend above and below the calm water level by a distance greater than the maximum height of the wave crests and maximum depth of the wave troughs, respectively, said baffles having a horizontal length at least as great as the maximum crest-to-crest length of the waves, said baffles having a horizontal width which is a small fraction of the length thereof, each of said baffles being hollow and having outwardly curved vertically-extending side-walls meeting at front and rear edges to form front and rear pointed ends, said baffles being equally spaced and defining therebetween passages of venturi-shaped horizontal cross-section with the width of the throat of the venturi being from one-fourth to one-half the distance between the front ends of adjacent baffles, each of said baffles having a plurality of conduits, each of said conduits communicating with the throat of the venturi and with a point of greater cross-section in said venturi, and said baffles being adapted to break waves into a plurality of separate streams and to entrain air therein so that the streams emerging from the device are substantially reduced in wave height.

3. A wave-breaking device comprising a plurality of vertically-extending wave-breaking baffles, means supporting said baffles in laterally spaced, aligned relation facing into the prevailing waves, said baffles being of such vertical dimensions as to extend above and below the calm water level by a distance greater than the maximum height of the wave crests and maximum depth of the wave troughs, respectively, said baffles having a horizontal length at least as great as the maximum crest-to-crest length of the waves, said baffles having a horizontal width which is a small fraction of the length thereof, each of said baffles being hollow and having outwardly curved vertically-extending side-walls meeting at front and rear edges to form front and rear pointed ends, said baffles being equally spaced and defining therebetween passages of venturi-shaped horizontal cross-section with width of the throat of the venturi being from one-fourth to one-half the distance between the front ends of adjacent baffles, each of said baffles having a plurality of conduits, each of said conduits communicating with the throat of the venturi and with a point of greater cross-section in said venturi, a plurality of horizontally-extending flat plates extending between each of said vertically-extending baffles and substantially coextensively therewith, said flat plates being spaced vertically from each other at a distance substantially equal to the distance between the pointed ends of adjacent vertically-extending baffles, said flat plates dividing said venturi-shaped passages into a plurality of separate vertically-spaced passages, and said baffles being adapted to break waves into a plurality of

separate streams and to entrain air therein so that the streams emerging from the device are substantially reduced in wave height.

4. A wave-breaking device comprising a plurality of wave-breaking baffles of substantial height and length but very small in lateral width, float means supporting said baffles vertically in laterally spaced, aligned relation and adapted to be anchored with said baffles facing into the waves, said baffles being of such vertical dimensions as to extend above and below the calm water line by a distance greater than the maximum height of the wave crests and depth of the wave troughs, respectively, each of said baffles having pointed front and rear ends and outwardly curved wall portions extending from the front to the rear ends with the baffles defining therebetween a plurality of separate passages of venturi-shaped cross section with the width of the throat of the venturi being from one-fourth to one-half the distance between the front ends of adjacent baffles, each of said baffles having a plurality of conduits, each of said conduits communicating with the throat of the venturi and with a point of greater cross-section in said venturi, a plurality of horizontally-extending flat plates extending between each of said vertically-extending baffles and substantially coextensively therewith, said flat plates being spaced vertically from each other a distance substantially equal to the distance between the pointed ends of adjacent vertically-extending baffles, said flat plates dividing said venturi-shaped passages into a plurality of separate vertically-spaced passages, and said baffles being adapted to break waves into a plurality of separate streams which emerge at the rear of the device substantially reduced in height.

5. A wave-breaking device comprising a plurality of wave-breaking baffles of substantial height and length but very small in lateral width, a plurality of elongated pontoons of a length at least two times the maximum crest-to-crest length of the waves and supporting said baffles vertically in laterally spaced, aligned relation and adapted to be anchored with said baffles facing into the waves, each of said baffles having pointed front and rear ends and outwardy curved wall portions extending from the front to the rear ends with the baffles defining therebetween a plurality of separate passages of venturi-shaped cross section with the width of the throat of the venturi being from one-fourth to one-half the distance between the front ends of adjacent baffles, a plurality of horizontally-extending flat plates extending between each of said vertically-extending baffles and substantially coextensively

therewith, said flat plates being spaced vertically from each other at a distance substantially equal to the distance between the pointed ends of adjacent vertically-extending baffles, said flat plates dividing said venturi-shaped passages into a plurality of separate vertically spaced passages, and said baffles being adapted to break waves into a plurality of separate streams which emerge at the rear of the device substantially reduced in height.

6. A wave-breaking device comprising a plurality of vertically-extending wave-breaking baffles of substantial height and length but very small in lateral width, a plurality of elongated pontoons of a length at least two times the maximum crest-to-crest length of the waves and supporting said baffles in laterally spaced, aligned relation and adapted to be anchored with said baffles facing into the waves, said baffles being of such vertical dimensions as to extend above and below the calm water level by a distance greater than the maximum height of the wave crests and maximum depth of the wave troughs, respectively, said baffles having a horizontal length at least as great as the maximum crest-to-crest length of the waves, each of said baffles being hollow and having outwardly curved vertically-extending side walls meeting at front and rear edges to form front and rear pointed ends, said baffles being equally spaced and defining therebetween passages of venturi-shaped horizontal cross-section with the width of the throat of the venturi being from one-fourth to one-half the distance between the front ends of adjacent baffles, each of said baffles having a plurality of conduits, each of said baffles communicating with the throat of the venturi and with a point of greater cross-section in said venturi, and said baffles being adapted to break waves into a plurality of separate streams and to entrain air therein so that the streams emerging from the device are substantially free of wave motion.

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CERTIFICATION OF CORRECTION

Patent No. 2,994,201 August 1, 1961

Le Roi E. Hutchings

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, lines 5 and 6, strike out "is such that the passages between adjacent baffles 2".

Signed and sealed this 24th day of April 1962.

(SEAL)
Attest:

ESTON G. JOHNSON
Attesting Officer

DAVID L. LADD
Commissioner of Patents