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FLOATING BREAKWATER FOR REFRAINING
THE WAVE MOTION OF WATER
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Fig. 1

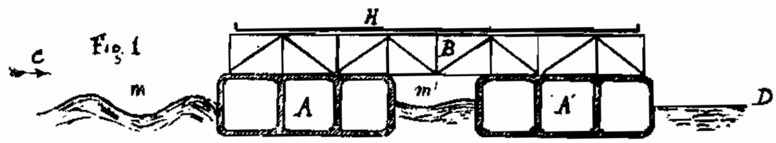


Fig. 2

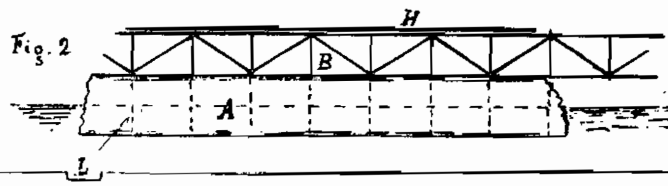
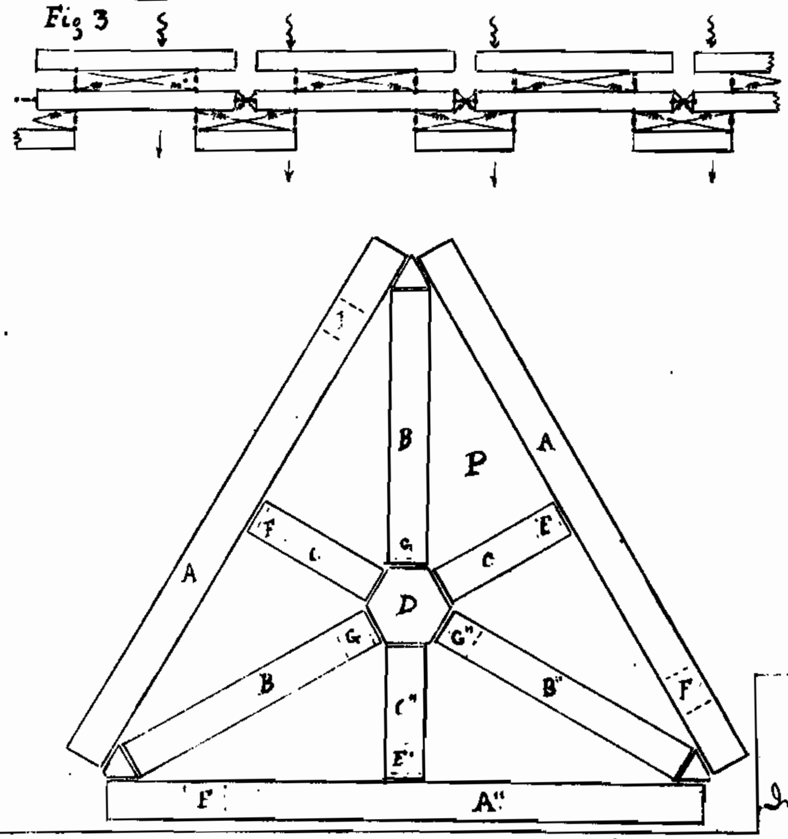


Fig. 3



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FLOATING BREAKWATER FOR REFRAINING THE WAVE MOTION OF WATER

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Application filed October 21, 1938

As it is known, the wave motion of sea and lakes is due to the pendular elliptic motion of the liquid particles under the action of the wind, by which the water surface appears like a plurality of trochoidal cylinders which displace, as figures, according to the direction of the wind and are tangent to the ellipses (with the longer axis horizontal) described by the liquid particles.

It is also known that a relation exists between the height of the waves and the distance from each other thereof; moreover, when the waves meet an obstacle they undergo a substantial modification of shape losing a considerable part of their energy. Said helicoidal motion is not only superficial but extends somewhat also in the deep and the particles beneath describe ellipses whereof the diameter decreases as the depth increases.

Of course, reference is made here to wave motion in high sea, practically deprived of any transport or hit action, in contrast to that near the shore or influenced by the bottom.

The present invention has for its object to dampen said wave motion, and refers to a floating breakwater consisting of at least two floating beams, at a suitable distance from each other, but connected and fastened to each other by a rigid structure.

A floating system of this kind, sufficiently long with respect to the troughs formed by the waves, when situated so as to afford its side parallel to the main line of the waves or oblique thereto, will attain the effect of dampening, in correspondence to each single beam, the wave motion so that the same will be considerably lessened after having gone beyond the first beam, owing to the frontal obstacle afforded by the same as well as to the friction resistance of its walls and specially of its bottom wall. The successive passages against and under the next beams will succeed in completely dampening the waves, thus creating a calm region leeward which may result absolute and perfect if the number of the successive beams constituting the breakwater is suitable to the circumstances.

Moreover, the rigid connection between the various beams, which fastens the same to each other, establishes a certain compensation between the undulatory movements to which the various beams would singularly undergo, when said movements are not synchronous, this concurring in producing the dampening desired and rendering the construction more stable, thus affording to the same the real character of a breakwater capable of refraining the wave motion.

The efficacy of said leveling or breaking effect may be most considerable if the width of each single beam and the distance between two successive beams will be conveniently selected with respect to the maximum length of the waves or the troughs created by the same in the spot where the breakwater is placed and the leveling effect will be obviously enhanced by the longitudinal extension of the system, also upon this extension depending the stability of the system against any direction of the wave motion with respect to the direction of the floating breakwater, said stability influencing in turn the same leveling effect aimed.

So as to better clarify the nature and the range of the invention, the same will be described hereinbefore with reference to the attached drawing wherein:

Fig. 1 represents diagrammatically the cross section of a breakwater consisting of two floating beams rigidly coupled to each other as well as the profile of the wave motion in the presence of this floating system;

Fig. 2 represents the breakwater in a side view;

Fig. 3 represents also diagrammatically a mode of connecting various distinct sections of such floating systems, with the object of refraining the wave motion on very long distances or very long waves, in which cases more of such articulate independent systems might be used as successive parallel filters;

Fig. 4 represents diagrammatically another of the numerous other structures obtainable by the employ of the beams according to the invention.

In Fig. 1 two floating beams A, A' are supposed to be connected to each other by rigid transversal structures B keeping the same at a suitable distance. The floating system thus composed is supposed to be merged by more than half the thickness of the floating beams in a water surface whereon waves m arrive in the direction C, which waves, in the absence of said floating system, would continue to extend by successive undulations. The presence of the float A, instead, causes that the wave, already in contact with the first vertical wall of the first obstacle, cannot reach the primary height both by the superficial friction against said wall and the facility wherewith the local hydrostatic pressures depending upon the differences of level of the waves may find their way under the beam either in whirls turning back towards the low part of the same wave, or generating currents sliding under the plane basis of said beam. Having passed beyond the obstacle consisting of said first float, therefore, the waves are considerably flattened, as it appears in m', so that in the interspace between the two floats A, A' a considerably calmed zone is formed. In correspondence to the beam A' the same phenomena take place with a further dampening of the wave motion, so that after the beam A, that is towards D, the water level may be considered as practically constant. Should, however, this not happen, the wave motion being either too violent or such that the crest of the wave should overflow the upper plane of the first obstacle, it will be sufficient to multiply the number of the successive obstacles.

The determination of width of the beams A, A' and the like and the distance between successive beams represent a problem of pure hydrodinamic technics which must be placed taking into account of the local circumstances which may be foreseen or determined by direct observation; the same is to be said about the draught to be established for the work so that no discontinuity of contact with the water should take place thereunder. Of course it will be preferable that the aforesaid distance should be equal to a semi-wave or to a multiple or submultiple thereof, in relation to the characteristics of the most probable or most ample wave motion, and it will be also preferable that the single obstacles should have an wide base, smooth or rough or, if desired provided with fins or vertical walls projecting downwards, whereunder the most efficient absorption of kinetic energy from the wave could take place by friction.

Practically the structure according to the invention may take the form represented by Fig. 1, wherein each of the floats A, A' has a rectangular cross section and is, for instance, subdivided into cells by means of internal vertical partition indicated by the dotted lines L Fig. 2; longitudinal partitions also may be introduced. These two beams are connected to each other by rigid transversal structures B, consisting, for instance, of parallel girders, which may be covered by a longitudinal continuous floor H whereon a road may pass or loads, airplanes and the like may rest.

Obviously, therefore, when a wave strikes the outer side, for instance, of the beam A, said wave, after having lost a great part of its own kinetic energy against the side and under the basis of said beam, finds between beams A and A' a space of storage and rest, after which it finds a very efficient further dampening against the wall and under the basis of the second float. The dampening action will be still more efficient when the successive floats will be more than two.

If the transversal connecting structures B upon the floating beams A A' and the like will be connected to each other by other girders incorporating the transversal girders and parallel to the length of the floating system, as indicated by Fig. 2, a planking having the real consistency of a continuous beam will be obtained, said planking being capable of withstanding bending and twisting moments, independently from the own resistance of the floating beams. Said beams A, A' and the like, therefore, may be, in some cases, individually continuous as described in the Patent Specification 2,029,004, or else they may consist simply of ranges of floating caissons, even separated from each other, made of any material such as wood, sheet metal, cement, plates of artificial resins and the like, and connected to each other and to the girder above by any suitable means; when the floating girders are continuous, however, it will be necessary, to obviate to thermal effects, not only that they be vertically sectioned (by double waterproof walls nearly touching) for the emerging part, but also that the reticular structure thereupon be longitudinally sliding with respect to said beams, whereto said structure must be rigidly connected in one point only and slidingly connected in all the other points. Said floating systems consisting either of continuous beams or ranges of caissons, may be constructed either on the spot according to said Patent Specification 2,029,004, or else in the dock-yard and then launched and towed to the spot, where they may be fastened to the above girder B, either in contact with each other or somewhat removed longitudinally in two or more ranges. The transversal or longitudinal connecting girder B of Figs. 1 and 2 may also be assembled before placing the caissons or the forms for the progressive moulding in water of the floating beams, as indicated by Fig. 2, right, to facilitate thus the performance of the work also on wavy water, by temporarily connecting said forms to the girder for the moulding operation.

It is not necessary that the floating structures according to the invention should develop in a straight line; they may develop according to any polygonal or curved profile or form articulated compositions as that diagrammatically represented by Fig. 3, so that it may result very easy to construct not only floating roads (as the dampening effect in question has a considerable influence on the stability of the work) but also floating wharfs or quays and moles, and also very long continuous or articulated breakwaters for the formation of ports of very low cost and completely free from any requirement of natural configuration of the shore or bottom, high sea parts and finally floating airports, which might serve also for hydroplanes, when at least three floating breakwaters be disposed so as to circumscribe a zone of sea with or without an entrance aperture. For constructing a floating airport, for instance, the most simple and rational construction would be the one represented by Fig. 4, consisting of three floating beams A, A', A'', disposed so as to form an equilateral triangle, which should form already three paths for starting and arriving, at 120° to each other so that six azimuth directions to be utilised in relation to the direction of the wind. The number of paths might further increase when the structure be provided internally with diagonal or radial branches B, B', B'' and C, C', C'', which should bring, with the foregoing, the number of the directions to 12. In both cases, within the floating beams a zone or zones of calm water would be constituted, wherein hydroplanes might descend and rest; said zones might communicate with one another under the platforms and also with the exterior, through the passages E, E', E'', F, F', F'' and G, G', G'' or otherwise.

Of course, the above triangular structure has been described as a non limitative example, any other conformation suitable for each being adoptable without exceeding the limits of the invention.

Moreover, the shapes of the floating beams, their constitutive materials, the forms of their connections and the structures of the superimposed floors may be selected according to requirements. Of course, also the processes to follow for the construction in water of the manufactured pieces required will vary.

It is equally obvious that these breakwaters must be anchored to the sea bottom or to the shores in a sufficiently loose way as it is used for the ships in the high sea, considering that they will result much more stable than ships.

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