

Fig. 1.

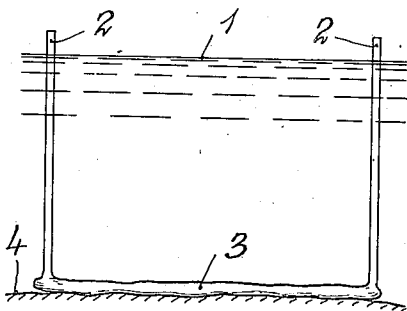


Fig. 2.

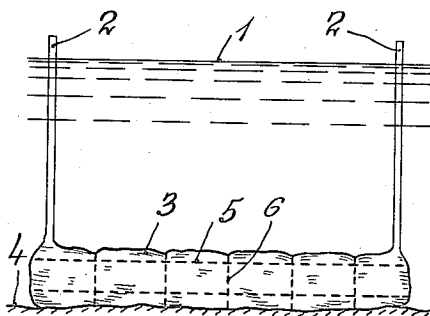


Fig. 3.

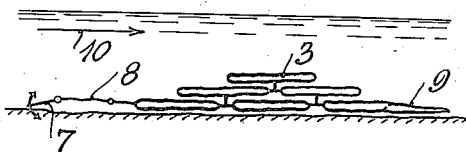


Fig. 4.

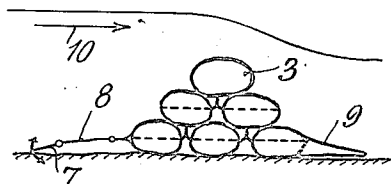


Fig. 5.

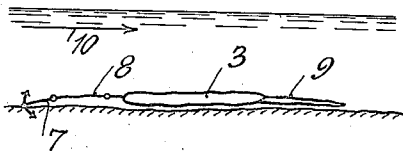
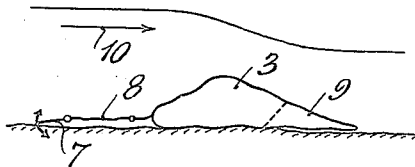


Fig. 6.



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 METHOD OF CONSTRUCTING SUBAQUEOUS CONCRETE STRUCTURES.
 APPLICATION FILED MAY 27, 1920.

1,421,857.

Patented July 4, 1922.
 3 SHEETS—SHEET 2.

Fig. 7.

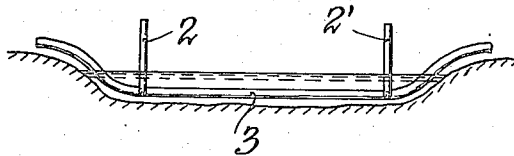


Fig. 8.

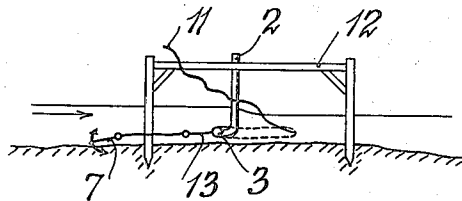


Fig. 9.

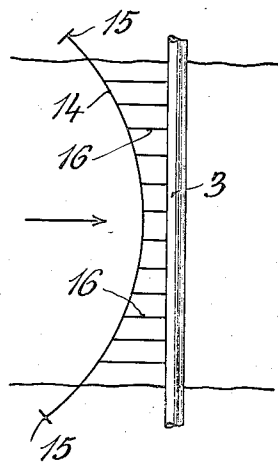
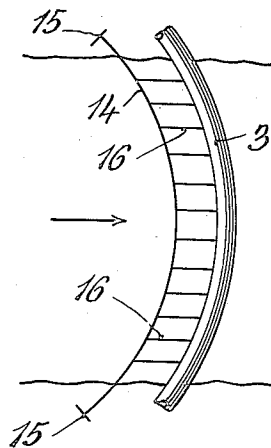


Fig. 10.



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3 SHEETS—SHEET 3.

Fig. 11.

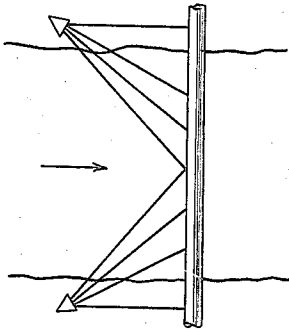


Fig. 12.

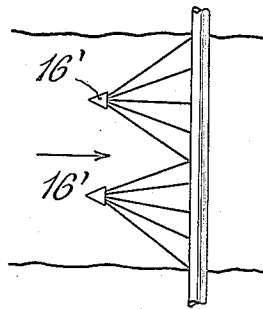


Fig. 13.

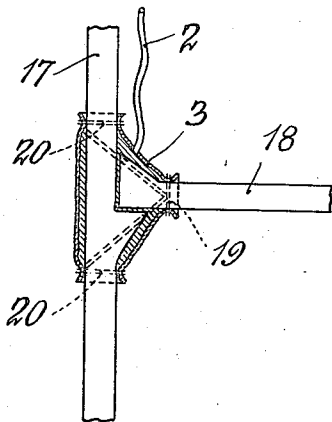
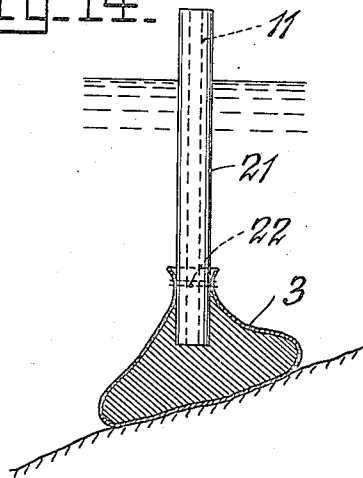


Fig. 14.



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UNITED STATES PATENT OFFICE.

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METHOD OF CONSTRUCTING SUBAQUEOUS CONCRETE STRUCTURES.

1,421,857.

Specification of Letters Patent.

Patented July 4, 1922.

Application filed May 27, 1920. Serial No. 394,518.

To all whom it may concern:

Be it known that I, JOHAN STÖRE, a subject of the King of Norway, residing at Christiania, Norway, have invented certain new and useful Improvements in a Method of Constructing Subaqueous Concrete Structures; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention relates to a method of constructing subaqueous concrete structures, and the principal object thereof is to dispense with the use of expensive pilings, dams and similar expedients, but nevertheless preventing the concrete from being washed away before it sets.

The novel method consists essentially in filling the concrete into pliable, substantially watertight containers, positioned below the surface of the body of water in which the work is to be done. The containers are preferably of such size and character that, when filled, they will assume approximately the size and shape of the object to be cast.

I am aware that it has been heretofore proposed to fill, or partly fill, containers with concrete and then to lower the filled or partly filled containers into position, but my invention differs fundamentally from this procedure in that I first deposit the empty containers in position below the surface of the water and then fill or partly fill them with the desired material.

The invention may be practiced in many different forms, and for the purpose of illustrating the practical application of the process reference is made to the accompanying drawings wherein—

Figure 1 illustrates diagrammatically the casting of a subaqueous foundation, Fig. 1 showing the parts before the method is begun and Fig. 2 the same parts after completion of the method; Figs. 3 and 4 are views illustrating the formation of a mole or dam; Figs. 5 and 6 are views similar to Figs. 3 and 4, with the exception that in the case of Figs. 5 and 6 but a single container is employed, while in Figs. 3 and 4 a plurality of containers are used; Figs. 7 and

8 illustrate means for rapidly filling and emptying the container; Figs. 9 to 12 are plan views of various means to anchor the containers during the filling thereof; Figs. 13 and 14 illustrate the application of the present method to structural parts which are connected or built up, partly or entirely, before being submerged.

Referring to Figs. 1 and 2 of the drawings, 1 denotes the water level above which project the ends of the filling tubes 2, the latter having their lower ends connected to the containers 3 to be supplied with concrete. The containers may be provided with reinforcement bars and stays 5 and 6 which automatically assume their proper positions when the container 3 is being filled. In proceeding according to Figs. 1 and 2, the container 3 is lowered to the bottom 4 and thereafter the concrete or other filling material is fed through the filling tubes 2. The container is preferably evacuated of air and water, as completely as may be, before being lowered into position, and the concrete is desirably forced through the tubes 2 into the container 3 under suitable pressure to counteract and overbalance the pressure of the water on the container 3. As the container 3 is preferably made of substantially waterproof material there is no danger of the concrete therein being washed away before it sets.

In Figs. 3 and 4 two superimposed rows of containers 3 with a single upper container are shown, the filling tubes being omitted. In practice the lowermost row is first filled, then the intermediate row is filled, and finally the uppermost container is filled. The containers may be held in place on the bottom by a cable 8 secured to an anchor 7, and I may also provide at one side of the containers an apron 9 to preventing washing away of the ground from under the containers. The direction of the current of the stream is indicated by 10.

Figs. 5 and 6 are much like Figs. 3 and 4, except that in Figs. 5 and 6 but a single container 3 is employed.

In Figs. 7 and 8, the filling tubes 2 and 2', leading to the container 3, have cables 11 attached thereto, which may be manipulated from the scaffolding 12 and permit the tubes to be swung into any desired position. Fig. 7 is a transverse view of the stream and Fig. 8 a longitudinal section thereof.

For the purpose of anchoring the contain-

ers during the filling operation any of the means of Figs. 9 to 12 may be adopted. Speaking generally, these means consist of a main cable 14 anchored at 15, and having 5 attached thereto auxiliary cables 16 to which the containers 3 are secured. In Figs. 11 and 12 the main cables are dispensed with, the auxiliary cables being secured directly to suitable anchors 16'.

10 Figs. 13 and 14 illustrate the use of the present method for fastening or connecting parts that are more or less complete before being submerged, as parts of quay-foundations, bridge-foundations, pile-foundations 15 or the like. The parts that are to be interconnected by being imbedded in the concrete mass are enclosed in a waterproof, empty bag or hose of canvas or the like, provided with the necessary means for being filled 20 with liquid casting mass after having been sunk below the water level. Fig. 13 is a diagrammatic side view of a part of a quay-foundation and Fig. 14 is a side view of a pile-foundation. In the construction shown 25 in Fig. 13 the process is carried out as follows:—

A container 3 is placed about the inter-connection point between the vertical post 17 and the horizontal beam 18. For the purpose of covering this interconnection with 30 concrete to prevent the iron reinforcement bars connecting the parts 17 and 18 from being eaten by rust, the bag or hose 3 is made tight about the bars 17 and 18 against the surrounding water by aid of bindings 19 35 and 20. This having been done the liquid concrete, preferably under pressure, is fed through the tube 2, extending above the water level, so as to fill the container 3 as 40 indicated in the drawings. In this way the reinforcement irons will be completely covered and protected against the effect of the water. In a similar way all iron connections 45 below the water level may be covered by the use of containers that are shaped to answer the needs of the special purpose for which they are used. The method may also be used for connecting pillars, posts or the like 50 to the bottom of the water as illustrated in Fig. 14. The concrete pile or post 21 has been ready cast, as usual, and floated to the place where it is to be installed. For purpose of installation a water-tight bag 3 is 55 fastened on to the lower end of the pile. This bag must be of a shape and size adapted to the condition and configuration of the bottom of the stream. When the bag has been securely fastened by aid of the bindings 22, the pile is lowered completely or almost 60 completely to the bottom, whereupon the bag is opened out and if desired anchored by a diver, whereupon the liquid concrete is fed through one or more tubes (not shown) or through one or more special casting chan- 65 nels 11, formed in the pile or post itself.

These channels may, if desired, be subsequently filled with solid materials as broken rock or the like. In this way the pile and foundation block will be cast together so as to form an integral body.

70 The bottom part of the bag may be made of loose canvas or other not quite watertight fabric in order that the concrete may partly pass through it and set directly against the bottom surface.

75 In all the forms used for the practice of the method, there may suitably be provided small tubes for letting out the air collected in the containers after they have been put in place, and also for letting out water which 80 may have leaked in.

For the purpose of temporarily damming streams (for instance for log floating purposes), I may fill the containers 3 (Figs. 3 85 and 4) with water under pressure instead of with liquid mortar. In some cases I may also use air under pressure for this purpose.

I claim:—

1. The herein described method of forming subaqueous structures, which consists in 90 submerging a chamber below the surface of the water and thereafter feeding casting material into such chamber to inflate the same.

2. The herein described method of forming subaqueous structures, which consists in 95 submerging a flexible chamber capable of variation in form, and thereafter feeding casting material into such chamber to inflate the same.

3. The herein described method of forming 100 subaqueous structures, which consists in submerging an enclosed chamber capable of form variation, and thereafter feeding casting material into such chamber to inflate the same.

4. The herein described method of forming 105 subaqueous structures, which consists in submerging an enclosed chamber capable of form variation, and thereafter feeding casting material into such chamber from above 110 the water surface to inflate the same.

5. The herein described method of damming streams, which consists in submerging 95 an enclosed chamber capable of form variation, and forcing liquid under pressure into 115 such chamber to inflate the same.

6. Means for forming subaqueous structures, comprising a submersible pliable container, and filling means connected to said 120 container and extending from the latter to above the water surface.

7. Means for forming subaqueous structures, comprising a submersible pliable container, filling means connected to the container and extending from the latter to 125 above the water surface, and means for anchoring the container to the water bed.

8. Means for forming subaqueous structures, comprising a submersible pliable container, filling means connected to the con- 130

tainer and extending from the latter to above the water surface, means at one side of the container for anchoring the latter to the water bed, and means at the other side
5 of the container to prevent the soil from being washed away from under the container.

9. The herein described method of forming subaqueous structures, which consists in submerging a collapsible substantially water-
10 proof, enclosed chamber capable of form variation in empty condition and thereafter feeding casting material into such chamber to inflate the same.

10. Means for forming subaqueous structures, comprising a submersible pliable container, filling means connected to the container and extending from the latter to above the water surface, and means for let-

ting out air or water collected in said container, said means extending from the latter
20 to above the water surface, and means for anchoring the container to the waterbed.

11. Means for forming subaqueous structures comprising a submersible pliable container, filling means connected to the container and extending from the latter to
25 above the water-surface, and collapsible iron reinforcement rods fastened by strops to the inside of the container.

In testimony that I claim the foregoing
30 as my invention, I have signed my name in presence of two subscribing witnesses.

JOHAN STÖRE.

Witnesses:

NATH. A. HEDENOCHON,
ROBERT H. FRAZIER.