Dec. 4, 1945. G. VAN DER REST 2,390,403

METHOD AND APPARATUS FOR LAUNCHING REVETMENT MATS

Filed Jan. 14, 1944 2 Sheets-Sheet 1

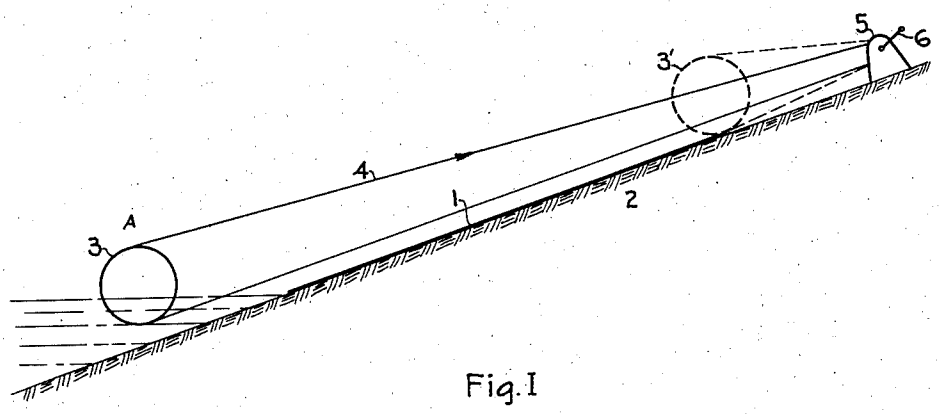

Fig. I

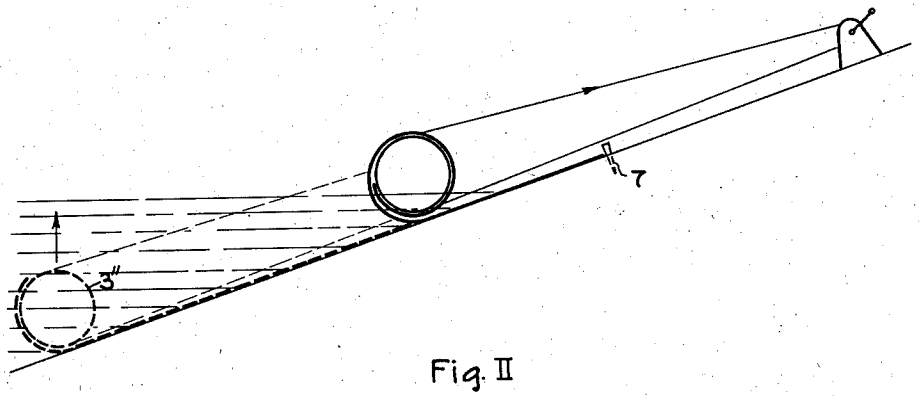

Fig. II

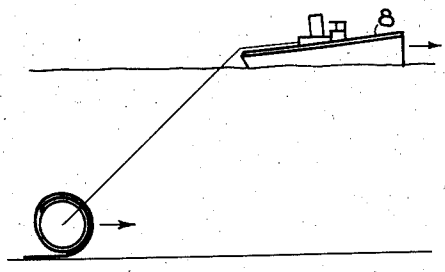

Fig. III

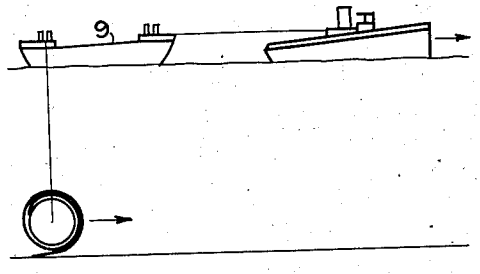

Fig. IV

Inventor: Gerard van der Rest

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METHOD AND APPARATUS FOR LAUNCHING REVETMENT MATS

Filed Jan. 14, 1944 2 Sheets-Sheet 2

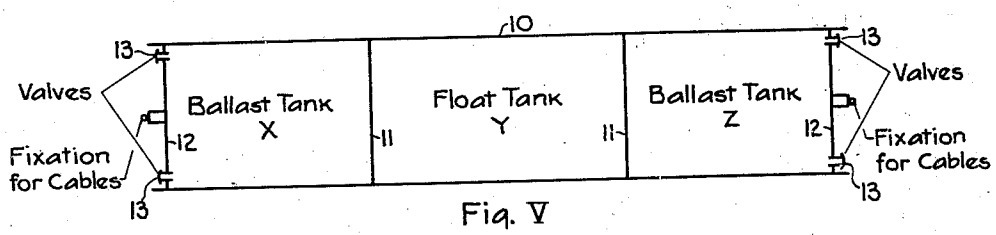

Fig. V

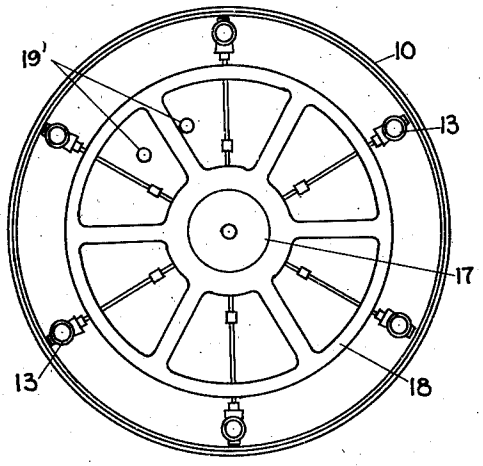

Fig. VII

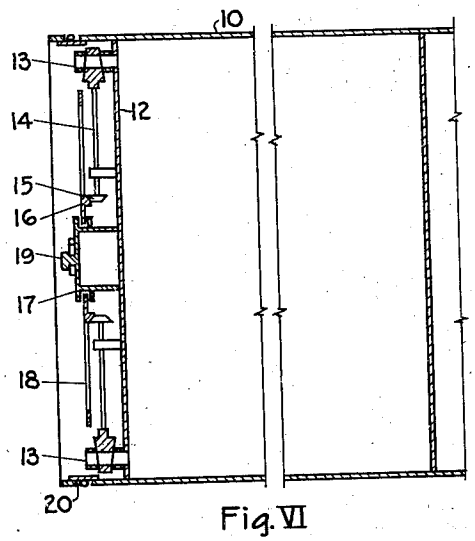

Fig. VI

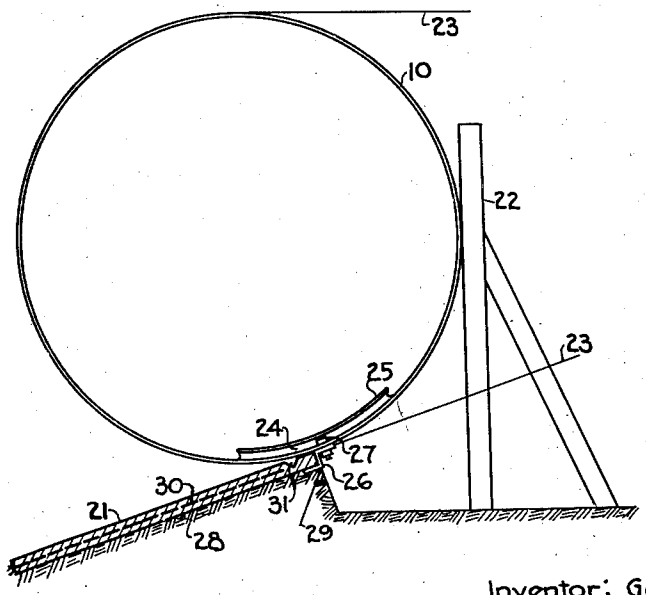

Fig. VIII

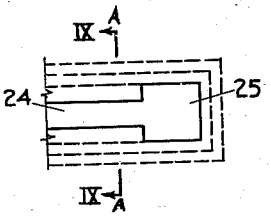

Fig. X

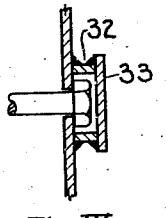

Fig. IX

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Patented Dec. 4, 1945

2,390,403

UNITED STATES PATENT OFFICE

2,390,403

METHOD AND APPARATUS FOR THE LAUNCHING OF REVETMENT MATS

Gerard van der Rest, Carmel-by-the-Sea, Calif.

Application January 14, 1944, Serial No. 518,488

6 Claims. (Cl. 61—38)

This invention deals with the under water placing of pre-fabricated revetment mats for the protection of shores or relatively shallow bottoms of waters such as rivers, canals, lakes, bays, or even parts of an ocean.

Various types of revetments have been used in the past to protect dykes, levees, bottoms of rivers and canals, etc. from the destructive action of currents, waves and turbulence. Among the best of such revetments have been reinforced flexible asphalt mats, which were pre-fabricated at some suitable location and then were transported to the desired spot and laid as best could be done. While suitable mats have been available, their placing, however, particularly under water, offered considerable difficulties. Especially designed boats were required, and equipped with much special and expensive machinery.

It is the placing under water or launching of pre-fabricated mats with which this invention is primarily concerned, as well as with certain details of the mat itself and the mechanical equipment needed to launch it. It is thus a purpose of this invention to provide a relatively simple and inexpensive method for placing pre-fabricated revetment mats under water. It is another purpose to carry this out without the need of specially designed boats or launches, all equipment with exception of a float drum described later being conventional. Still another purpose is to make possible by this invention the use of mats which require less heavy reinforcement and are thus much cheaper to build than was possible heretofore. Further purposes are the provision of a suitable sinkable float drum (to carry the mat to the desired location of placing) with means for sinking and refloating it, and means for holding and discharging the mat at the proper moment.

Briefly, the invention comprises manufacturing a suitable mat on or near the shore of the water where it is to be placed, wrapping it onto a drum, moving the so loaded drum to the exact at least partially submerged location for placing the mat, and unwinding the mat by rolling the drum at least part way under water whereby the mat is laid. The drum minus the mat is then re-floated and used over.

Further details are discussed in connection with the several drawings and in subsequent paragraphs.

Figures I and II illustrate the method for wrapping a mat onto a drum and then unwrapping it on a submerged bank.

Figures III and IV show diagrammatically the method of unwrapping the drum on more or less level under water floors.

Figure V is a schematic elevated view of a drum employed for laying the mats.

Figure VI is an elevated cross sectional view of the left hand end of a drum, showing the valve mechanism.

Figure VII is a side view of the same drum and valve mechanism.

Figure VIII is a cross sectional side view of a drum resting on the upper edge of a mat prior to wrapping it on, showing a slot and clamp needed to fasten the mat onto the drum.

Figure IX is a cross sectional side view of the slot shown in Figure VIII.

Figure X is an enlarged bottom view of the same slot.

Referring to Figure I, a mat 1 manufactured on a suitable site 2, preferably close to the water's edge, is wrapped onto a drum 3 shown in position A. A cable 4 is strung from the foot of winch 5 around drum 3 floating on the water and back to the roll of winch 5. When operating winch 5 as by moving handle 6 in clockwise direction to draw up the cable 4, drum 3 is first pulled to the edge of the water and then is slowly rolled up the embankment 2 over the mat 1. Drum 3 is rolled to the upper edge of mat 1 or close to it (position 3'). The edge is clamped to the drum in a manner described later. This done, the drum is then allowed to slowly back down, wrapping up the mat as it rolls.

Where the site for manufacturing the mat is of a more or less permanent character, additional equipment to facilitate the placing of the drum on the upper edge of the mat may be employed. Thus, for example, the drum may be loaded on two trucks travelling on rails along both sides of the mat. These trucks are pulled up the grade with winches and deposit the drum at the desired spot.

After the complete mat has thus been wrapped onto the roll, the end is fixed by means of spikes driven into it and through the underlying layers of mat, or else, if a greater degree of fixation is needed, by means of easily detachable bands or cables. This is necessary in order to prevent premature unwrapping of the mat in subsequent movements. If spikes are used, it is desirable that they be pre-coated with asphalt.

The drum now loaded with the mat is moved into the water where it floats and is brought to the exact location where the mat is to be laid. If the location for laying the mat is a shore embankment as shown in Figure II, the drum is

turned around so that the original farther end of the drum is now the near end. It is then rolled up the grade by means of cables and winches, as described in connection with Figure I, to a line where it is desired to anchor the upper end of the mat. At this point, the spikes or bands, as the case may require, are removed and valves which are provided in the end plates of the drum, are opened. Then the drum is slowly allowed to roll back down into the water. As soon as the upper end of the mat lies flat, it may be anchored to the ground by anchor 7 as shown in Figure II. If the slope is insufficient at any one point to allow the drum to roll of its own accord, it may be pulled from the water side. As the drum enters the water, the open valves permit water to enter into it, as a result of which it continues rolling down (position 3''). The construction of the drum is such (as will be described later) as to permit entry of an amount of water sufficient only to sink it while loaded with the mat, but to allow it to float without the added weight of the mat. As a result the drum sinks and continues to roll on as far as the guide cables will let it.

The unrolling of the mat causes the drum to become lighter and on account of its construction will again float when most of the mat has been unwrapped. When the mat is completely unwrapped, the buoyancy of the drum causes it to tear loose from the mat. The mat settles to the bottom of the water, and the free floating drum rises and is recovered. If the drum fails to tear loose from its own buoyancy, pulling it with cables will help.

When employing the above scheme, it is usually necessary to employ two or more winches (preferably coupled so that they forcibly turn at the same speed) for each rolling operation in order to prevent the drum from deviating from a straight path. Any side turn of the drum while the mat is being wrapped or unwrapped may result in damage to the mat or uneven laying or both. This may cause a much shorter life of the revetment than should normally be expected.

The maximum speed at which the drum may be rolled to wrap or unwrap the mat is in general quite low and is limited by the flexing properties of the mat and the diameter of the drum. Flexibility of the mat in turn is a function of its thickness, type of binder, aggregate, temperature, etc. So no hard and fast rule can be laid regarding the speed of wrapping. On the average, a 2-inch asphalt mat on a 6 to 8-foot drum may be wrapped at the rate of about 15 minutes per turn.

If the water is navigable a tug, or tug and barge may be used to tow the drum to the location of sinking, to guide the sinking drum and to unwrap the sunk drum. If, however, the distance of transporting the drum through navigable waters is relatively long, the charged drum may be carried at least part of the distance in a cradle between two barges.

In order to lay mats on relatively level bottoms of navigable waters, the methods depicted in Figures III and IV may be employed. In this situation, the drum charged with the mat is sunk from a tug 8 or barge 9 at the location of laying after the spikes or other means of fixing the loose end of the mat have been removed. After reaching bottom, the drum is then slowly rolled with cables attached to the tug, thereby unwrapping the mat.

In canals and small rivers which often have a relatively strong current, a cross cable may be strung from bank to bank, and the drum may be floated to the desired location by means of a block travelling on the cross cable, a second cable being attached to the travelling block extending downstream the necessary distance. The mat is then again unrolled with cables and winch as described for Figure II.

In laying mats in waters having a current in one direction, it is important to have the several mats overlap, the overlapping ends pointing downstream. So in lining a canal or river or the like with mats, one has to begin downstream and work upward.

From the above description, it will be realized that in order to carry out the wrapping, unwrapping, floating, sinking and re-floating successively, it is necessary that the mat and the drum meet certain requirements.

Obviously, the mat must have a certain tensile strength as well as flexibility. Mats having these properties are quite well known and have been produced in the past. In general they are made of asphalt concrete reinforced with wire nets, cables, fabrics, etc.

Inasmuch as the mat must be floated and sunk, the specific gravity of the composition is of some importance. In general, it has been found that specific gravity stays fairly close to about 2, normally ranging from about 1.5 to 2.5 or in extreme cases as high as 3.

While the mat must have some tensile strength, it is in general not necessary that it be heavily reinforced. Ordinary chicken wire, fish netting, duck or even weaker materials are usually of sufficient strength. The reason why the heavy reinforcements can be dispensed with lies in the particular method of launching which I have invented. Heretofore it was necessary to launch such mats over the side of a boat, for instance by the method described by Shearer in U. S. Patent 1,229,152. Because of the enormous weight of the mat when laying it at relatively great depths, the strong steel cable reinforcements were required.

The sizes of the mats may vary between extremely wide limits. In general it is desirable to make them as large as can be handled in order to reduce the number of seams, seams being the most vulnerable places where destruction of the revetment may set in. Thus both the width and the length of each mat may be several hundred feet, although 100' x 150' is probably the most useful average size. The thickness may also vary, depending upon the conditions to which the mat may be exposed during its useful life. Thicknesses of from about 1 to 3 inches are most practical and suit most applications.

In general, it is desirable to standardize the composition as well as size and thickness of mats to be laid in any one job; or if different measurements or compositions are required, at least reduce their number to a minimum. This is because no one launching drum is entirely suitable to handle mats of widely varying measures, and the necessity of having to use many different drums complicates the handling and raises the cost.

For further information on the manufacture of flexible mats of the type described herein, reference is had to U. S. Patents 1,874,567; 1,991,196 and 2,047,197.

In order that the mat shall not stick to itself when wrapped up on the drum, it is sometimes necessary to sprinkle it with a dry powder. Talc,

diatomaceous earth, limestone powder, clays, etc., and many other mineral or organic powders may be used.

The drum for floating and launching the mat also must meet certain requirements. It must be able to float the mat; it must allow the intake of sufficient water to sink it while carrying the wrapped-up mat, and it should re-float, preferably on its own accord after having unwound and deposited the mat. For these reasons, the weight of the drum itself plus the weight of the mat may obviously not exceed the buoyancy of the drum. This places an upper limit on the weight of any mat that can be launched with any particular drum. In order to accommodate as large a mat as possible, it is therefore desirable that the drum alone be relatively light. On the other hand, it must be built sufficiently strong so that it will not deform under the rough handling to which it is likely to be exposed. Suitable building materials comprise various steels, aluminum, magnesium alloys, brasses, plywood, etc.

Diameters of drums may range from about 2 to 20 feet, although in some instances still bigger or smaller drums may be used. Their length may be anywhere from say 10 to 200 feet, more or less. Inside, the drum should be divided into compartments which permit partial filling with water while leaving at least one compartment empty for floating the drum after discharge of the mat. The size of the empty compartment must be sufficient so that the buoyancy of the partly water filled drum is at least slightly greater than the weight of the empty drum.

Referring to Figure V, a suitable drum **10** (which is preferably, though not necessarily cylindrical as shown) is divided into three compartments, X, Y and Z by partitions or bulkheads **11**. Compartments X and Y are ballast tanks which can be filled with water by opening the valves **13** at both end plates **12** of the drum. Compartment Y is a float tank sealed so that no water can enter at any time. Its volume is sufficient to cause the drum alone to float, even when the two ballast tanks are completely filled with water. On the other hand the ballast tanks must be large enough to cause the drum to sink when charged with a revetment mat.

If desired, sealed compartments having a total volume equal to that of Y may be at other locations inside of the drum to take the place of compartment Y. However, they should be axially disposed so that the drum is free to rotate when in water, and moreover they must be distributed over the length of the cylinder in such a way that the drum tends to sink in a horizontal position and will not nose down on one side.

Valves **13** must be positioned so as to permit entry of the water at the right moment. This can be achieved either by having a series of valves circularly arranged close to the periphery of the end plates **12**, so that regardless of which sector of the cylinder is submerged, water can flow in upon opening them; or else by providing a detachable weight or handle or the like which gives the drum a definite top and bottom sector, and by further providing a top and bottom valve in each of the two end plates **12**.

Since the valves must frequently be opened while the drum is afloat, it is desirable to provide a mechanism which can be operated by reaching from a boat. Such a suitable valve mechanism is shown in Figures VI and VII. Alternatively a jerk cord mechanism or the like may be employed to enable the opening of the valves by an operator standing on a boat or on dry land some distance away.

Referring to Figures VI and VII, **10** is the shell of the drum and **12** the end plates adjoining the ballast tank X, plate **12** carrying the valve mechanism. Six valves **13** are shown circularly arranged on end plate **12** near its periphery. They are of the plug valve type requiring only a quarter turn for opening and closing. Each plug carries a valve stem **14**, at the end of which there is a conical cam wheel **15**. All six cam wheels **15** match a central cam wheel **16** whose plane of rotation is at a 90° angle to the planes of rotation of cam wheels **15**. **16** is attached to hand wheel **18** capable of rotating (within limits) around the central hub **17** mounted on the end plate **12**. Stops **19'** restrict the movement of the hand wheel **18**. When turning the hand wheel **18** within the limits permitted by stops **19'**, central cam **16** turns the cam wheels **15**, which in turn open or close the valves **12**.

Knob **19** on top of hub **17** serves as a fixation point for cables which may be needed to tow the drum, or raise it should it fail to rise by itself. Groove **20** in the shell **10** near the edge of the drum serves as a guide for cables when wrapping or unwrapping the mat.

A detail not to be overlooked is the clamp for attaching the end of the mat to the drum when starting the wrapping onto the drum in accordance with Figure I. A suitable device for this purpose is shown in Figures VIII, IX and X. In Figure VIII, drum **10** is shown to rest on the end of mat **21**. The mat lies on support **28** which is conveniently made of some firm material such as concrete, the end of the mat coinciding with the edge **29** of the support. The drum is held against stop **22** by cable **23**. In the lower part of the drum (as positioned in Figure VIII) there is a peripheral slot **24**, an enlarged bottom view of which is shown in Figure X and a cross-section thereof along line AA is shown in Figure IX. This slot has a rectangular enlargement **25** at one or both ends, large enough to take the head of a suitable bolt. The slot **24** itself only accommodates the neck of the bolt. The inside of the entire slot is closed off by side walls **32** and covering **33**. This is necessary to prevent water from entering the drum. While the length of the slot as shown is about ⅙ of the circumference, it may be longer or shorter. If desired, it may reach completely around the drum.

A Z-shaped clamp **26** is used to attach the end of the mat **21** to the drum. In order to put this clamp in place, bolt **27** is slipped through a hole in the clamp and a matching nut is screwed on loosely. The head of the bolt is then inserted in opening **25** and the clamp-bolt assembly is then made to slide along slot **24** to the end of mat **21** at the edge **29** of support **28**. The clamp is then pushed over the end of the mat and is tightened by tightening the nut.

In order to hold the mat along the entire length of the drum, it is of course necessary to provide more than a single peripheral slot **24**. In general, it is desirable to have slots at least about every 4 to 8 feet along the entire length of the drum. The clamp **26** may consist of a single piece extending the length of the drum; or it may be of several pieces, each piece preferably covering at least two slots.

In order to facilitate the pushing of the clamp over the end of the mat, it may be desirable to provide a shim under the end of the mat at edge **29**, which shim is removed just before inserting

the clamp. Or else the end of the mat may hang a short distance over the edge 29.

The clamp thus holds the mat attached in a fixed position and unless the clamp is put on loosely or loosened, the mat is held rather firmly. This might result in some difficulty in disengaging the drum from the mat after the latter has been unwrapped. To make sure that the mat will slip off at the right moment, it is desirable that the reinforcement in the mat shall not extend to the very end which is held in the clamp, but be just slightly short of it as shown in Figure VII, 30 being the reinforcement in mat 21. The end, if not reinforced, has very little tensile strength, and should the mat fail to slip out of the clamp when needed, it will merely tear off, thereby permitting the mat to properly lie and release the drum. A cut or notch 31 in the mat will further facilitate the tearing off.

It may be desirable to cut openings into the mat at regular intervals which, if properly placed so as to coincide with the clamp when wrapping up the mat, may serve as windows through which the clamp may be loosened before the drum is launched. If this is done, the end of the mat will simply slip out when unwrapped. Openings in the mat are frequently necessary anyway, to allow water to escape that may have found its way under the mat. A convenient size for windows is about 4'' x 4''.

If desired, provision may further be made to introduce air into the drum should it for some reason refuse to re-float as described. This however would require the attachment of air hose through openings axially located in the two end plates 12, as well as a mechanism for closing the top valve of valves 13 while the drum is under water.

While in the preceding paragraphs I have described various mechanical details of the apparatus which is needed for carrying out my invention, it is understood that equivalents obvious to those skilled in the art may be employed.

I claim as my invention:

1. Method for laying a pre-fabricated flexible revetment mat in a submerged location comprising wrapping said mat onto a float drum, moving the drum so charged into the water to float it, towing it to said location, causing water to enter the drum in an amount sufficient to sink it and to be deposited in said location, rolling the sunk drum on the location to unwrap and lay the mat, disengaging the drum from the unwrapped mat and floating the disengaged drum.

2. Method for laying a pre-fabricated flexible revetment mat in a submerged location comprising wrapping said mat onto a float drum, moving the drum so charged into the water to float it, towing it to said location, causing water to enter the drum in an amount sufficient only to sink it while charged with at least a substantial portion of said mat but to allow the uncharged drum to float, rolling the sunk drum on said location to unwrap and lay the mat, and disengaging the drum from the unwrapped mat whereby the drum is re-floated.

3. The method of laying a prefabricated flexible revetment mat in an at least partially submerged location comprising wrapping said mat onto a float drum, moving the drum so charged into the water to float it, moving the floating drum to a submerged edge of said location, causing water to enter the drum in an amount sufficient to sink it, rolling the sunk drum to unwrap and lay the mat on said location and disengaging the drum from the unwrapped mat.

4. A method for laying a prefabricated flexible revetment mat in a submerged location, comprising wrapping said mat onto a float drum, moving the drum so charged into the water to float it, moving the floating drum to the desired position over said location, causing water to enter the drum in an amount sufficient to sink it onto said location, rolling the sunk drum to unwrap and lay the mat on said submerged location and disengaging the drum from the unwrapped mat.

5. A method for laying a flexible revetment mat in an at least partially submerged location, comprising manufacturing said mat on a flat sloping site above the water, placing a float drum on the upper end of said mat, the axis of said drum being substantially parallel to said upper end, attaching said end to said drum, slowly rolling the drum downward to wrap the mat onto the drum, moving the drum so charged into the water to float it, moving the floating drum to the desired position, causing water to enter the drum in an amount sufficient to sink it onto said location, rolling the sunk drum to unwrap and lay the mat on said location, and disengaging the drum from the unwrapped mat.

6. A method for laying a flexible revetment mat in an at least partially submerged location comprising manufacturing said mat on a flat sloping site above the water, placing a float drum on the upper end of said mat, the axis of said drum being substantially parallel to said upper end, attaching said end to said drum, slowly rolling the drum downward to wrap the mat onto the drum, securing the remaining loose end of the mat to the drum, moving the drum so charged into the water to float it, moving the floating drum to the desired position, causing water to enter the drum in an amount sufficient to sink it onto said location, rolling the sunk drum to unwrap and lay the mat on said location, and disengaging the drum from the unwrapped mat.

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