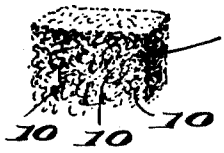
June 30, 1970 C. VISSER 3,517,514

SOIL PROTECTION MATS

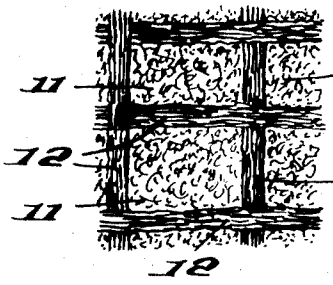
Filed March 8, 1968

Fig. 1.



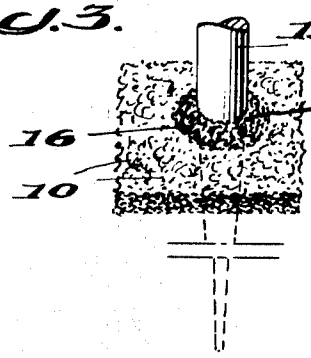
REVETMENT MAT OF NON-WOVEN FABRIC OF RANDOMLY ORIENTED FIBERS, e.g. POLYPROPYLENE, OR NON-DECAY RESISTANT FIBERS, e.g. NATURAL FIBERS.

Fig. 2.



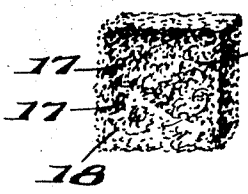
REVETMENT MAT OF RIBBED, WAFFLE FORM, NON-WOVEN FABRIC OF RANDOMLY ORIENTED FIBERS.

Fig. 3.



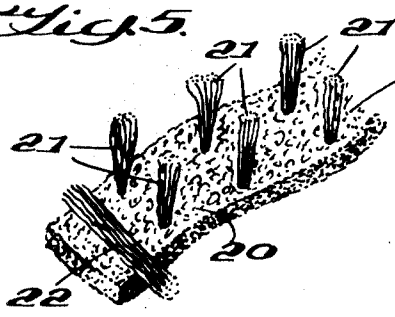
DENSIFIED COLLAR PRODUCED BY STAKING OF REVETMENT MAT OF NON-WOVEN FABRIC OF RANDOMLY ORIENTED FIBERS.

Fig. 4.



REVETMENT MAT OF NON-WOVEN FABRIC OF RANDOMLY ORIENTED FIBERS, COMPRISING DECAY RESISTANT FIBERS, e.g. POLYPROPYLENE, COMBINED WITH DECAYABLE FIBERS FOR RESTORING POROSITY.

Fig. 5.



REVETMENT MAT OF NON-WOVEN FABRIC OF RANDOMLY ORIENTED FIBERS WITH MUD RETAINING FIBER BUNDLES OR TUFTS.

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3,517,514

SOIL PROTECTION MATS

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U.S. Cl. 61—38 10 Claims

ABSTRACT OF THE DISCLOSURE

Revetment mats of non-woven fabrics having randomly oriented fibers are disclosed. Staking to a bank densifies the fabric about the stake rather than widening its meshes as occurs with woven fabrics. Polypropylene fibers are used. They resist attack by *Eriocheir sinensis*. Combinations of natural and synthetic fibers are employed; the decay of the former restores porosity to the fabric when soil tends to clog the same. Bundles of long loose fibers are fastened in the mats. They extend upwardly therefrom into the water. They cause mud particles in the water to deposit on the mats. This aids in securing the mats and in land reclamation work. Waffle-like formation may be used. The ribs strengthen the fabric. The compartments between ribs are thin and have relatively great permeability. Ribs or strips of polyester material reinforced with glass fiber may be attached. Strength and rigidity are correspondingly increased.

SPECIFICATION

Field of the invention

This invention relates to structures comprising mats for protecting earth from flowing waters, e.g. for preventing washing away of loose soil material from the banks and bottoms of rivers and by tidal waters (class 61). More particularly the invention relates to means for covering the soil employing bands of relatively thin materials which are fastened to the soil and to each other with the aid of stakes, piles, or pegs.

Description of the prior art

Dutch patent application 192,274 describes a bottom covering consisting of a number of flexible and elastic foils of synthetic material of very small thickness. Such bottom coverings have disadvantages. They shut off the soil completely, as a result of which seeping water cannot be let through, causing build-up of hydrostatic pressure behind the mats tending to displace or damage them. Moreover such thin foils are vulnerable to puncture and tearing, and special measures must be taken to protect them from damage.

So-called technical fabric has also been used as material for the protection of the soil. This fabric consists of fine-mesh woven material, usually fine-mesh woven synthetic threads. The sizes of the meshes are so chosen that they prevent passage of soil material therethrough, while permitting water seeping from the soil to pass through the meshes. Such technical fabric has the disadvantage that the fine meshes in the long run become clogged, as a result of which the soil is again shut off completely, with the above-mentioned disadvantages. An additional serious disadvantages of the woven materials as the phenomenon that at the place where the fabric is fastened to the soil the meshes about the fastening stake or peg become wider, permitting the underlying soil to be washed away. In fact, because an opening is made in the fabric by the pile or the peg, at that point the threads of the woof as well as the warp threads are bound to diverge from each other, as a result of which an area with wider meshes is formed around the opening, through which loose constituents of the soil may be washed away.

SUMMARY OF THE INVENTION

By the present invention mats are provided for the protection of soil from flowing water which do not present the above-mentioned disadvantages. According to the invention this object is achieved by the provision of a revetment comprising mats which consist essentially of fibers which are randomly oriented and intertwined by non-woven techniques known per se. The present invention has disclosed a unique advantage of this sort of revetment in that when the mats of randomly oriented fibers are pierced by stakes, piles, or pegs, the randomly oriented fibers compact into a dense ring about the fastening piles or pegs and in effect constitute a protective collar thereabout, and no inadmissibly large openings are formed anywhere in the mats. It has also disclosed that owing to the relatively loose connection between the fibers and their random orientation the mats can conform themselves closely to the surface configuration of the underlying soil without cracking, splitting or tearing.

In the preferred practice of the invention the size of the fibers and the non-woven technique are selected to produce mats which have sufficient porosity to permit passage of seeping water therethrough and in which owing to the sizes and forms of the passages present between the fibers in the vertical direction no solid soil particles can escape through the mat.

The mats of the invention may be formed of natural or synthetic textile material. In a preferred embodiment synthetic fibers are employed. These fibers are not attacked by the water and can easily be worked up into non-woven fabrics, while they have great tensile strength, as a result of which the mats made from them are very strong and practically immune from damage by sharp objects. In one preferred embodiment the mats are formed of polypropylene fiber, which appears to have the special advantage of not being attacked by *Eriocheir sinensis*. The mats can be produced in great lengths and of any desired thickness and strength, and can be fastened together in conventional manners.

In one advantageous embodiment the mats are made from a combination of natural and synthetic fibers. In this arrangement the decay of the natural fibers reestablishes porosity of the mats, or can even increase the size of the openings therein, after prolonged periods of use.

In another desirable embodiment of the inevntion the mats are provided on the surface in a number of places with bundles of long, loose fibers fastened in the mats. These bundles of fibers will extend in the water upwardly from the surface of the mats and thus form a means for detaining mud particles from the water. Thus in this embodiment the mats for the protection of the soil may serve at the same time as devices for the deposition and collection of mud for weighting down the mats or for aiding in land reclamation works.

In further embodiments the mats of the invention are densified on one or both of the surfaces, so as to adjust the openings therein to control their permeability for water. When synthetic fibers are used, this densification of the surface can be achieved in a very simple way by subjecting the surfaces of the mats to a heat-treatment similar to so-called "heat sealing" but conducted only to the extent appropriate to achieve the desired permeability control.

In yet another embodiment of the invention the tensile strengths of the mats are increased very considerably by the provision of an additional quantity of fibrous material

in the form of strips extending over the length and the width of the mats, so that compartments with relatively great permeabiliy are present between the strips, producing a somewhat waffle-like construction, and in order to ensure greater rigidity and strength, the mats may, for instance, be provided in a simple way with strengthening strips of polyester material reinforced with glass fiber.

The mats may be applied to horizontal and sloped surfaces or even in vertical positions, behind rows of pales, for example.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying diagrammatic drawings:

FIG. 1 represents a section of an embodiment of revetment mat used in and constituting a part of this invention;

FIG. 2 represents a section of a second embodiment;

FIG. 3 represents a stake driven through the embodiment of FIG. 1 and into an underlying terrain, and illustrates the effect thereof on the mat, and

FIGS. 4 and 5 represent sections of further embodiments.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIG. 1, in its simplest embodiment the invention comprises a revetment mat of non-woven fabric of randomly oriented fibers **10**. The mat is prepared by the known techniques employed in the textile art for forming non-woven fabrics, and is preferably relatively thin and strong so that a roll thereof may cover a substantial area of soil to be protected. While the thickness and density of the non-woven fabric may be varied within quite wide limits, determined in part by the nature of the soil and violence of the water flow to be coped with, thicknesses of one-eighth to one-half inch or so are preferred, or the mat may be of varied thickness comprising freely pervious areas **11** and strengthening areas **12** for example, of the waffle-like form illustrated in FIG. 2.

When the revetment mats so formed, as illustrated in FIG. 3, are pierced by a stake, peg, or pile **15** driven through the mat or mats and into the underlying soil, the randomly oriented fibers **10** thereof compact into a denser ring **16** around the fastening pile or peg **15**. The more dense structure of the collar area guards against washing away of the soil proximate to the stake or pile **15**, and the porosity of the randomly oriented structure in surrounding relation to the collar **16** is not altered or opened up by the securement.

For long life and resistance to decay the mats are preferably made of, or comprise structurally stabilizing proportions of, decay resistant fibers, polypropylene fiber being preferred. In certain instances it is desirable to combine with the structurally stabilizing quantity of polypropylene fiber or the like, a filling quantity of natural fiber susceptible to bio-chemical degradation. As will be evident from FIG. 4 the decay of the natural fiber **17** in use will produce further voids in the mat structurally stabilized by the synthetic fiber **18**, thereby increasing its porosity to compensate for clogging of various pores therein.

In the embodiment of FIG. 5, the flexible mat **20** is provided in a number of places on its surface with bundles of long, loose fibers **21** fastened in the mats. These fibers **21** may be from one to many inches long and the bundles may be suitably spaced apart, preferably by distances approximating the length of the fibers **21**, to perform the desired function of trapping mud particles carried by the flowing water for causing deposition of mud on the mat for aiding in retaining it in place, and for causing accretion in land reclamation work, for which the longer fibers **21** are particularly desirable. As illustrated in this embodiment the mats may be stiffened and strengthened by strips **22** of polyester material reinforced with glass fiber, which may be bonded to the randomly oriented fibers by an adhesive coating, a mutual solvent for causing adhesion,

and/or by fusing or sealing together by the application of heat as previously described.

While there have been described herein what are at present considered preferred embodiments of the invention, it will be obvious to those skilled in the art that minor modifications and changes may be made without departing from the essence of the invention. It is therefore understood that the exemplary embodiments are illustrative and not restrictive of the invention, the scope of which is defined in the appended claims, and that all modifications that come within the meaning and range of equivalents of the claims are intended to be included therein.

What is claimed is:

1. The combination with an area of soil juxtaposed to flowing water of a revetment covering, said revetment covering comprising

(a) a number of flexible revetment mats fastened together and to said area of soil,

(b) said revetment mats being formed of non-woven fabric of randomly oriented fibers.

2. A combination as claimed in claim **1**, in which

(c) said revetment mats of randomly oriented fibers comprise at least a structurally stabilizing proportion of synthetic fiber.

3. A combination as claimed in claim **1**, in which

(c) said revetment mats of randomly oriented fibers comprise at least a structurally stabilizing proportion of polypropylene fibers.

4. A combination as claimed in claim **1**, in which

(c) said revetment mats of randomly oriented fibers comprise a structurally stabilizing proportion of synthetic fibers and a filling proportion of biodegradable fibers the decay of which augments the porosity of the mats.

5. A combination as claimed in claim **1**, in which

(c) said revetment mats of randomly oriented fibers are provided with bundles of long loose fibers fastened in the mats and extending upwardly from the upper surfaces thereof.

6. A combination as claimed in claim **1**, in which

(c) said revetment mats of randomly oriented fibers are more dense in at least one of their surfaces than in regions removed from the surfaces thereof.

7. A combination as claimed in claim **1**, in which

(c) said revetment mats are secured by stakes, the randomly oriented fibers of said mats forming densified collars adjacent to said stakes.

8. A combination as claimed in claim **1**, in which

(c) said revetment mats of randomly oriented fibers are provided on their surfaces with strips of additional material.

9. A combination as claimed in claim **8**, in which said strips of additional material are arranged perpendicular to each other imparting a waffle-like formation to the revetment mats.

10. A combination as claimed in claim **8**, in which said strips consist of polyester reinforced with glass fiber.

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