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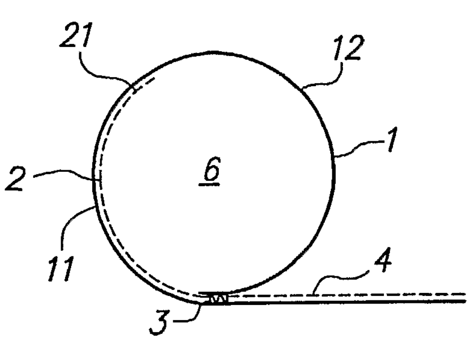
(54) Title: SEDIMENT CONTROL ROLL (SCR) AND METHOD OF COLLECTING SEDIMENT



(57) Abstract: A sediment control roll (SCR) includes a threshold member (1) having relatively large apertures therethrough, a hollow sediment collection chamber (SCC) (6), and an outflow filter (2) having relatively small apertures therethrough. The SCR preferably includes a location member (4) extending from the SCC. The SCR can be used to collect sediment in runoff from a construction site, or to reduce removal of sediment from an existing land mass. The SCR can for example be made by rolling up extruded polymeric netting with filter cloth attached thereto.

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SEDIMENT CONTROL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of my application Serial Number 10/843,010 filed May 11, 2004, which is a continuation-in-part of my application Serial Number 10/742,076 filed December 19, 2003. The entire disclosure of each of those applications is incorporated by reference herein for all purposes.

BACKGROUND OF THE INVENTION

This invention relates to the control of sediment. The term "sediment" is used herein to denote solid particulate material, e.g. soil, sand or pebbles, which can become suspended, or which is suspended, in a flowing stream of liquid, and which will settle out of the liquid when the liquid ceases to flow. The term "sediment control roll" (often abbreviated herein to SCR) is used herein to denote an article which can be transported and placed (i) on top of a substrate, usually the ground, in order to collect sediment from a sediment-bearing stream of liquid, usually water, which passes through the SCR, or (ii) around an existing land mass composed of, for example, soil, sand, pebbles or rocks, in order to prevent or reduce removal of sediment from the land mass by water flowing towards, along, over or through the land mass. The term “land mass” is used herein to include, but is not limited to, a slope, a gully, a beach, or the bank of a body of water, e.g. a river or lake.

It is often desirable to collect sediment from liquid in which it is suspended, or to stabilize an existing mass of sediment to prevent it from being carried away. In some cases, the law requires removal of sediment from liquid flowing out of a construction site. The conventional method for collecting sediment is to place hay bales or wattles across the path of the liquid. Other methods are described in, for example, U.S. Patent Nos. 6,422,787, 6,547,493 and 6,641,335, the disclosures of which are incorporated herein by reference.

SUMMARY OF THE INVENTION

In the present invention, sediment is collected by directing a sediment-bearing liquid successively through

(a) a threshold member which has a multiplicity of relatively large apertures therethrough and which reduces the speed of the sediment-bearing liquid,

(b) a substantially hollow sediment collection chamber (often abbreviated herein to SCC), and

(c) an outflow filter having a multiplicity of relatively small apertures therethrough.

The purpose in collecting the sediment can for example be to prevent it from being deposited at undesirable locations, or to prevent it from being removed from an existing land mass.

The threshold member, SCC, and outflow filter are conveniently combined together as an SCR. Preferably, the outflow filter is supported by an outflow member which has a multiplicity of relatively large apertures therethrough. In some embodiments, at least some of the sediment-bearing liquid, after it has passed through the threshold member and before it passes through the SCC, passes through a threshold filter having a multiplicity of relatively small apertures therethrough, for example a threshold filter which is supported by, e.g. secured to the inside of, the threshold member.

The SCC is "substantially hollow", the term "substantially hollow" being used herein to mean that the SCC has an unobstructed volume which is at least 50%, e.g. 50 to 98%, particularly at least 70%, e.g. 70 to 97%, for example at least 80%, e.g. 80 to 96%, of the total volume of the SCR. For example, in one embodiment, an outflow filter is secured inside the outflow member, and optionally a threshold filter is secured inside the threshold member and the volume between the threshold and outflow members is otherwise empty. The filter can be secured to the outflow member and/or to the threshold member in any convenient way, for example (a) by an adhesive (e.g. a thermal setting adhesive or a hot melt adhesive) or by melt bonding, and/or (b) by being sandwiched between the outflow or threshold member and an interior layer of the same or similar material having relatively large apertures therethrough. Alternatively (provided that the SCC remains "substantially hollow" as defined above), there can for example be additional members which occupy some of the space between the threshold and outflow members. Such additional members may or may not have a substantial effect on the flow of liquid through the SCC.

In many cases, the SCR preferably includes a location member which extends tangentially away from the threshold and outflow members. When the SCR is placed with its axis generally horizontal, for example to collect runoff from a construction site, the location member can be placed in a generally horizontal plane in contact with the ground, preferably so that the sediment-bearing liquid flows over the location member before reaching the threshold member. When assemblies of multiple SCRs are used, the location members can be used to secure the adjacent SCRs to each other.

In some preferred embodiments of the present invention, the SCRs are, after each use, removed, cleaned and reused, and, after repeated use, are recycled. In other preferred embodiments, the SCRs are left in place to form a retaining structure which stabilizes an existing land mass. In these embodiments, the SCR can not only collect sediment which would otherwise be removed from the existing land mass, but also reduce the scouring force of water flowing over, along or towards the land mass, e.g. water rushing down a gully or waves generated by wind and/or boats.

In a first preferred aspect, this invention provides an SCR which comprises

1) an elongate threshold member having a multiplicity of relatively large threshold apertures therethrough;

2) an elongate outflow member having a multiplicity of relatively large outflow apertures therethrough; and

3) an elongate outflow filter which

(i) is supported by, e.g. secured to, the outflow member and

(ii) has a multiplicity of relatively small filter apertures therethrough;

the SCR comprising a substantially hollow, elongate SCC which lies between the threshold member and the outflow member.

In one embodiment of the first aspect of the invention, the threshold and outflow members are provided by a single piece of an apertured polymeric sheet which has been shaped into a generally tubular configuration comprising overlapping layers of the apertured polymeric sheet (e.g. rolled up into a generally cylindrical shape). The overlap can be limited to the extent needed to secure the overlap areas to each other, for example 0.5-6 in. (12.5-150 mm), e.g. 0.5-3 in. (12.5-75 mm), or can be more extensive, for example so that at least 20% of the outflow filter (and/or threshold filter, if present) is sandwiched between the overlapping layers. Preferably the apertured polymeric sheet also extends from the tubular configuration, thus providing all or part of a location member; in this case, the roll can include a sheet of filter material which not only provides the outflow filter but also extends over at least part of the location member.

In a second preferred aspect, this invention provides a method of collecting sediment from a flowing stream of a sediment-bearing liquid which comprises

(A) passing the flowing stream through a threshold member having a multiplicity of relatively large threshold apertures (a) which pass through the threshold member and (b) whose size is such that at least a substantial proportion, e.g. all, of the sediment can pass through the threshold member;

(B) passing the liquid stream from step (A) through a substantially unobstructed SCC; and

(C) passing the liquid stream from step (B) through an outflow filter having a multiplicity of relatively small filter apertures (a) which pass through the filter and (b) whose size is such that at least a substantial proportion of the sediment cannot pass through the filter.

Often, because filter materials do not generally have sufficient physical strength to be self-supporting under normal usage conditions, the method also includes the step of

(D) passing the liquid stream from step (C) through an outflow member which supports the outflow filter and which has a multiplicity of relatively large outflow apertures passing through it.

Preferably, the sediment-bearing liquid is passed through an SCR as defined in the first aspect of the invention.

In one preferred embodiment, the flowing stream is run-off from a construction site. In another preferred embodiment, the flowing stream comes from an existing land mass, and the method prevents or reduces removal of sediment from that land mass.

In a third preferred aspect, the invention provides a method of making an SCR , preferably an SCR according to the first preferred aspect of the invention, the method comprising

(A) providing a precursor for an SCR , the precursor comprising (i) an apertured sheet material having relatively large apertures therethrough, and (ii) a sheet of filter material which has relatively small apertures therethrough and which is secured to part or all of the apertured sheet material;

(B) shaping, e.g. rolling up, the precursor to provide a generally tubular body (a) which comprises first and second parts of the apertured sheet material which overlap each other, and (b) in which at least part of the filter material is secured to at least part of an interior surface of the tubular body, e.g. portions of the filter material are sandwiched between the overlapping first and second parts of the apertured sheet material; and

(C) securing the overlapping first and second parts of the apertured sheet material together.

In step (C), the first and second parts can be secured together in any convenient way, e.g. by an adhesive, and/or by melt bonding, and/or by mechanical interlocking, for example by Velcro-like members, or by ties or hooks of metal or polymeric material. When the overlapping portions are secured together only by mechanical interlocking means, the interlocking means can be releasable, so that by releasing the mechanical interlocking means, the SCR can be restored to a relatively flat configuration for cleaning and/or storage and/or transport.

In one preferred embodiment of the third aspect of the invention, a portion of the apertured sheet material, preferably a portion having filter material secured thereto, extends tangentially from tubular body, thus providing a location member.

In a fourth preferred aspect, the invention provides a precursor suitable for use in the method of the third aspect of the invention, the precursor comprising

(1) an apertured sheet material having relatively large apertures therethrough, and

(2) a sheet of filter material which has relatively small apertures therethrough and which is secured to the apertured sheet material.

Such precursors can be substantially flat, making them easy to transport, e.g. to the site at which the SCRs are to be used. When such precursors are assembled at the site, the securing together of the overlapping first and second parts is preferably accomplished at least in part by mechanical interlocking.

The precursor can for example comprise a substantially rectangular apertured sheet material and a substantially rectangular sheet of filter material secured thereto, the sheet of filter material

(a) having substantially the same size as the sheet of apertured sheet material and being secured thereto with substantially coincident edges (as for example in Figure 8); or

(b) having a size which is substantially less the size of the sheet of apertured material and being secured to the sheet of apertured sheet material so that three of the four edges are substantially coincident (as for example in Figures 11 and 14); or

(c) having a size which is substantially less than the size of the sheet of apertured material and being secured to the sheet of apertured material so that two opposite edges of the filter material are substantially coincident with edges of the sheet of apertured material (as for example in Figures 17 and 20); or

(d) having a first dimension which is less than one dimension of the sheet of apertured material and a second dimension which is greater than the other dimension of the sheet of apertured material, and being secured to the sheet of apertured material so that a portion of the sheet of filter material extends beyond the apertured sheet material (as for example in Figure 25).

The precursor can include additional components, e.g. an additional layer of apertured polymeric sheet material and/or members for use in securing the overlapping parts together to provide the tubular body.

A preferred feature, which can be provided through the use of a precursor as defined in (d) above, is for the filter material to extend longitudinally beyond the tubular body. This extending portion can be wrapped around an adjacent SCR, and thus help to ensure that sediment cannot pass through the joint between the SCRs.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated in the accompanying drawings, which are diagrammatic sketches and are not to scale, and in which

Figures 1-3 and 7 are cross-sections through SCRs of the invention,

Figure 4 is a plan view of a part of the exposed surface of a typical threshold member,

Figures 5 and 6 are plan and side views of an assembly comprising six SCRs as shown in Figure 3,

Figures 8-9, 11-12, 14-15, 17-18 and 20-21 are top and cross-sectional views of five different precursors according to the fourth aspect of the invention, Figures 10, 13, 16, 19 and 22 are cross-sections of SCRs which can be prepared by rolling up and securing overlapping areas of the precursors shown in Figures 8-9, 11-12, 14-15, 17-18 and 20-21 respectively,

Figure 23 is a cross-section of an assembly of SCRs being used to stabilize a bank of soil,

Figure 24 is a cross-section, and Figure 25 is a plan view, of an SCR being used to control the flow of sediment-bearing liquid into a drain,

Figure 26 is a top view of another precursor according to the fourth aspect of the invention,

Figure 27 is a plan view of an SCR which can be prepared by rolling up and securing overlapping parts of the precursor shown in Figure 26, and

Figure 28 is a plan view and Figure 29 is an end view of an SCR similar to that shown in Figure 27, but having a bridge member secured thereto.

DETAILED DESCRIPTION OF THE INVENTION

In the Summary of the Invention above, the Detailed Description of the Invention, the Examples, and the Claims below, and the accompanying drawings, reference is made to particular features of the invention, including for example components, ingredients, devices, apparatus, systems and method steps. It is to be understood that the disclosure of the invention in this specification includes all possible combinations of such particular features. For example, where a particular feature is disclosed in the context of a particular embodiment, a particular Figure, or a particular claim, that feature can also be used, to the extent possible, in the context of other particular embodiments, Figures and claims, and in the invention generally. The invention claimed herein includes embodiments not specifically described herein and can for example make use of features which are not specifically described herein but which provide functions which are the same, equivalent or similar to, features specifically disclosed herein.

The term "comprises" and grammatical equivalents thereof are used herein to mean that other features are optionally present. For example, An SCR "comprising" (or "which comprises") components A, B and C can contain only components A, B and C, or can contain not only components A, B and C but also one or more other components. Where reference is made herein to a method comprising two or more defined steps, then, unless the context requires otherwise, the defined steps can be carried out in any order or simultaneously, and the method can include one or more other steps which are carried out before any of the defined steps, between two of the defined steps, or after all the defined steps. The term "at least" followed by a number is used herein to denote the start of a range beginning with that number (which may be a range having an upper limit or no upper limit, depending on the variable being defined). For example "at least 20%" means 20% or more than 20%. When, in this specification, a range is given as " (a first number) to (a second number)" or "(a first number) - (a second number)", this means a range whose lower limit is the first number and whose upper limit is the second number. For example, "0.5-3" means a range whose lower limit is 0.5, and whose upper limit is 3. The numbers given herein should be construed with the latitude appropriate to their context and expression. The term "multiple" is used herein to mean two or more. When reference is made herein to "a", "an", "one" or "the" feature, it is to be understood that, unless the context requires otherwise, there can be one or more than one such feature.

Where reference is made herein to two or more components (or parts or portions etc.), it is to be understood that the components can be, unless the context requires otherwise, separate from each other or integral parts of a single structure or a single component acting as the two or more specified components.

Threshold Members

The apertures in the threshold member (the "relatively large threshold apertures") have a relatively large size such that at least a large proportion, preferably all, of the sediment can pass through the threshold member, and preferably such that the speed of liquid directed at the threshold member is substantially reduced. The threshold member is preferably the first part of the SCR which opposes the flow of the sediment-bearing liquid. Often all the apertures have the same size and/or shape, though this is not necessary. The apertures can be of any shape, for example polygonal, including triangular and parallelogrammatic (including rectangular, e.g. square), round or oval. In some embodiments, each of the apertures is in the shape of a parallelogram in which the acute angles are from 60 to 82°, preferably 70 to 80°. Each of the apertures can for example have an area of 0.01 to 1.0, preferably 0.02 to 0.25, particularly 0.03 to 0.16, e.g. 0.04 to 0.1, in^2 (6.5 to 650, preferably is 13 to 160, particularly in 19 to 100, e.g. 25 to 65, mm^2), and/or a minimum dimension of 0.1 to 1.0, preferably 0.15 to 0.5, particularly 0.15 to 0.4, e.g. 0.2 to 0.3, in the (2.5 to 25, preferably 3.8 to 13, particularly 3.8 to 10, e.g. 5 to 7.5, mm). Such apertures provide little or no resistance to many of the sedimentary particles generally encountered in practice, but prevent the passage of larger objects floating on the liquid, for example sticks, cans and plastic bottles.

The greater the ratio of solid surface area to the total area of the threshold member, the more the threshold member will slow down the stream of sediment-bearing liquid. This reduction in the speed of the stream of liquid is accompanied by deflection of the sediment-bearing liquid in many directions. Both factors enhance removal of sediment from the liquid which has passed through the threshold member. However, if the stream is slowed too much, part of it may not be able to pass through the threshold member, and as a result some of the sediment-bearing liquid may flow over the top of the threshold member without any sediment being removed therefrom. In some embodiments of the invention, the solid surface area of the threshold member is 10 to 80%, for example 25 to 65%, of the total area of the exposed surface of the threshold member, both areas being viewed at right angles to the threshold member.

The threshold member can be composed of a multiplicity of strands, e.g. polymeric strands, connected together at junction points, thus providing a solid network, against and through which the sediment-bearing liquid flows. The thickness of the polymeric strands, viewed at right angles to the plane of the threshold member, can for example be 0.08 to 0.3 inch (2 to 7.5 mm), e.g. 0.1 to 0.2 inch (2.5 to 5 mm). Thus, materials suitable for use as the threshold member can be in the form of the heavier grades of netting obtained by melt-extruding an organic polymer. Methods for producing such netting are well-known, and may for example make use of two rapidly rotating, opposed extrusion heads, each set to extrude polymeric strands at the same angle to the principal axis of the resulting product, i.e. the machine direction. The resulting netting comprises generally parallelogram-shaped apertures defined by (i) a multiplicity of first strands which are parallel to each other and (ii) a multiplicity of second strands which are parallel to each other, the first strands and second strands being at the same angle to the principal axis of the netting. Especially when preparation of the SCR includes rolling, or otherwise shaping, a length of such netting to provide the threshold member, and/or the outflow member, the acute angle between the first and second strands is preferably 60 to 82°, for example 70 to 80°. Preparation of such netting requires modification of the well-known techniques for preparing extruded netting, but those skilled in the art will have no difficulty, having regard to their own knowledge and the disclosure of this specification, in preparing such netting. The netting is preferably rolled (or otherwise shaped) so that the machine direction of the netting runs transversely around the resulting roll.

The threshold member is preferably composed of a polymeric composition (i.e. a composition containing a polymer and conventional additives such as fillers) which can be melt shaped, particularly a composition which does not absorb substantial amounts of water in use and/or which can be recycled and/or which is resistant to ultraviolet light, e.g. through the inclusion of 2-3% by weight of carbon black. Suitable polymers for the composition include polyolefins, particularly high density polyethylene and polypropylene. The polymer, in part or all of the threshold member, can be cross-linked, for example by exposure to electron beam radiation. It is preferable to avoid the use of polymeric compositions which can decompose, or release materials harmful to the environment, including wildlife, for example polymers containing plasticizers. Other materials that can be used for the threshold member are suitably apertured metal sheets, and interconnected metal wires, optionally coated with synthetic polymers.

When the threshold member is made up of two (or more) overlapping layers of the same (or different) apertured material, the effect of the threshold member on the stream of sediment-bearing liquid will depend upon the extent to which the strands defining the apertures overlap. If the apertures are all the same size and are directly on top of each other, the effective size of the apertures and the solid surface area of the threshold member of the two layers will be much the same as for only one of the layers. On the other hand, if the solid strands defining the apertures are staggered, the effective size of the apertures will be reduced, for example by 30-50% and the solid surface area will be increased, for example by 30-50%.

Outflow Members

The description above of threshold members is also applicable to outflow members. In many cases, the outflow and threshold members are provided by a single piece of suitable apertured material which is cut and shaped to provide the desired relationship between the two members and the rest of the SCR. However, the outflow and threshold members can be separate pieces of the same apertured material, or separate pieces of different apertured materials.

If it is desirable to recycle the SCR, the outflow member is preferably composed of a material which is the same as the threshold member and the filter(s), or which can be recycled in the same batch as the threshold member and filter(s).

The threshold and outflow members are preferably composed of materials, and have dimensions, such that the SCR has adequate strength, toughness and flexibility, without the need for additional support members. High density polyethylene offers a good balance between strength, flexibility, toughness, stability, cost, availability, ease of recyclability, and environmental acceptability. Other satisfactory polymers include polypropylene and low density polyethylene.

Filters

The outflow filter is contacted by the sediment-bearing liquid after the sediment-bearing liquid has passed through the threshold member and the SCC, and before it passes through the outflow member. In some embodiments, there is also a threshold filter which is contacted by the sediment-bearing liquid before it passes through the SCC. When there is both an outflow filter and a threshold filter, they may be composed of the same or different filter materials. For example, the size of the apertures in the outflow filter can be smaller than the size of the apertures in the threshold filter.

The sediment which passes through the threshold member (and through or over the threshold filter, if present) precipitates in the substantially hollow SCR either as a result of the reduction in the speed and/or change in direction of the liquid, or because it cannot pass through the outflow filter, and therefore drops down in front of, or is retained in, the outflow filter. If there is a threshold filter, sediment will initially be deposited in front of the threshold filter; but as time goes on (or if there is a sudden surge of sediment-bearing liquid), the sediment-bearing liquid may flow over the top of the threshold filter, directly into the SCC, thus depositing further sediment therein.

The outflow filter can extend over substantially all of the outflow member so that the capacity of the SCC is as large as possible. However, in some embodiments, the outflow filter extends over only a lower section of the outflow member, the lower section extending for example from the bottom of the outflow member to an upper level which is at least 50%, e.g. 50 to 90%, preferably at least 70%, e.g. 70 to 90%, of the height of the SCR.

The threshold filter, if present, can extend over substantially all of the threshold member, or can extend over only a lower section of the threshold member, the lower section extending from the bottom of the threshold member to an upper level which is at least 20%, e.g. 20 to 90%, or at least 35%, e.g. 35 to 80%, or at least 60%, e.g. 60 to 90%, of the height of the SCR. The top of the threshold filter, if present, may be at a lower level than the top of the outflow filter. For example, the top of the outflow filter maybe higher by at least 10%, preferably by at least 30%, of the height of the SCC. In another embodiment, there is a section at the top of the SCR which is free from filter material.

If the characteristics of the sediment-containing liquid can be predicted, then the characteristics, including but not limited to the mesh size, of the outflow filter (and of the threshold filter if present) can be selected accordingly. In general, the filter layer(s) have a mesh size (measured by ASTM E-11) of 80 to 600 micron, preferably 100 to 500 micron, e.g. about 100 micron. Such filters are commercially available. The filter material can for example be sheet material having a substantially uniform thickness of less than 0.5 in. (12.5 mm) or less than 0.25 in. (6 mm), for example 0.01-0.06 inch (0.25-1.5 mm), preferably 0.01-0.05 inch (0.25-1.3 mm.), e.g. 0.015-0.045 inch (0.4-1.2 mm).

In tests in which clean water is passed through the filter material, on its own, the filter material, depending on its mesh size, is generally capable of passing at least 10, e.g. at least 20, gallons of water per square foot per minute, but not more than 60 or not more than 40, e.g. 18 to 35, gallons of water per square foot per minute (at least 0.4 m^3, e.g. at least 0.8 m^3, but not more than 2.5 m^3 or not more than 1.6 m^3, e.g. 0.7 to 1.4 m^3 of water per m^2 per minute).

Filter materials used in the present invention may need to be supported so that they are not displaced by the flowing liquid. In some embodiments, the filter material is secured to the outflow member or the threshold member. Alternatively or additionally, the threshold filter or the outflow filter may be secured to an interior support member. The interior support member can for example be an apertured polymeric sheet which is the same as the outflow member and/or the threshold member, or which has apertures larger than those in the outflow member and/or the threshold member. When the compositions of the threshold and outflow members and of the filter(s) and of the interior support member(s) if present, are such that they can be melt-bonded together (for example when they are composed of the same organic polymer), they are preferably secured to each other by melt bonding, for example along discrete lines or at discrete areas. Alternatively or additionally, they can be secured to each other, for example along discrete lines or at discrete areas, by adhesive, e.g. a thermal setting or melt adhesive, and/or through mechanical means, e.g. Velcro-type patches, or hooks or ties of metal or polymeric material.

The filter(s) is(are) preferably composed of a synthetic polymer, particularly a polymer which does not absorb substantial amounts of water in use and/or which can be recycled. Suitable polymers include polyolefins, particularly high density polyethylene and polypropylene. If it is desirable to recycle the SCR, the filter is preferably composed of a polymer which can be recycled in the same batch as the threshold and outflow members, and which is preferably the same as the polymer in the threshold and outflow members.

SCRs

The threshold member, filter(s) and outflow member are preferably secured together so that they form an SCR as defined above. The threshold member, filter(s) and outflow member can be secured together in any convenient way.

The SCR is preferably both strong and flexible so that it can be easily handled and will accommodate to uneven substrates, but yet will not be rendered unusable by rough treatment of the kind that is difficult to avoid at construction sites, for example people standing on and vehicles passing over the SCR. Preferably, the SCR, if subjected at room temperature, 70°F (21°C), to a test in which a weight of 200 lbs (90 kg) is applied uniformly to a 1 foot (300 mm) long section of the top of the SCR for 20 seconds, and is then removed, the height of the SCR, in the section underneath the weight, decreases by at least 25%, often at least 60% or at least 70%, e.g. up to substantially 100 %, before the weight is removed, and recovers to at least 60%, particularly at least 75%, of its original height within one hour of the weight being removed. Preferably, the threshold and outflow members are shaped, and have sufficient tensile and flexural strength, to ensure that this is the case, without the need for additional support members. However, the SCR can contain additional support members to provide desired dimensional stability. The invention includes the possibility that the SCR is in a collapsed form which is suitable for storage and transport and which can be converted into usable form, e.g. a precursor according to the fourth aspect of the invention.

It is preferred that all the parts of the SCR are constructed so that the roll does not absorb substantial quantities of water. For example, it is preferred that the roll, when subjected to a test which consists of

(i) completely immersing the roll in water for 0.5 hour,

(ii) removing the roll from the water,

(iii) placing the roll on a horizontal apertured surface, and

(iv) leaving the roll to drain for 0.5 hour in still air at 20°C,

has a weight after the test which is not more than 1.3 times, preferably not more than 1.1 times, its weight before the test.

It is preferred that the SCR is constructed so that, in a test in which clean water is directed towards the roll at right angles to the threshold member, the roll is capable of passing at least 10, e.g. at least 20, gallons of water, but not more than 40 gallons of water, per square foot per minute (at least 0.4 m^3, e.g. at least 0.8 m^3, but not more than 1.6 m^3, of water per square meter per minute) of the frontal area of the threshold member (i.e. the area of the threshold member as viewed from the front, e.g. for a cylindrical roll, the length times the diameter of roll). In such a test (and indeed likewise in practice) the structure of the roll is generally such that the volumes of water entering and leaving any particular length of the roll are substantially the same (e.g. differ by less than 20%, preferably less than 10%, based on the volume of water entering the roll), since the roll does not function as a pipe to direct liquid to the ends of the roll.

The dry weight of the SCR is preferably such that it can readily be transported and placed in position manually. The weight may be for example 0.2 to 2.5, e.g. 0.35 to 1.0, lb per linear foot of SCR (0.3 to 3.7, e.g. 0.5 to 1.5 kg/m), with a total weight of for example 1 to 15 lb. (0.45 to 7 kg), preferably less than 8 lb (3.5 kg).

The tubular SCRs of the present invention can be of any cross-section. Generally, but not necessarily, they have a constant cross section. SCRs having a generally circular cross section are easy to prepare, but SCRs having other cross sections, for example oval or polygonal (including, for example, triangular and rectangular, including square) are also possible, and the greater base area of tubes of polygonal cross-section makes them more stable when placed in a generally horizontal position on the ground.

End Sections of SCRs

The end sections of the SCRs of the invention can be completely open, or can be closed by a suitable end member, which may be apertured. The end member may be constructed so that it provides physical support for the roll and reduces the risk of the end of the roll being inadvertently crushed. Alternatively or additionally, the end member may be constructed so that two or more SCRs can be joined together in line to provide an extended SCR. For example, one or both ends can include a bridging member which fits inside the SCC and can be fitted inside an adjacent roll. When the SCR is to be used to control the flow of sediment-bearing liquid into a drain, the ends of the SCR can be shaped and/or include (or be used in conjunction with auxiliary components, e.g. sandbags), to ensure that little or no liquid can enter the drain without passing through the SCR.

Location Members on SCRs

As noted above, it is often preferred that the SCR includes one or more location members which extend away from the SCR. When the SCR is to be placed in a generally horizontal position on the ground, e.g. to collect sediment from run-off from a construction site, the location member can be used to " key-in" (i.e. secure the SCR in place), for example by driving one or more stakes through the location member(s) into the ground, and/or by scattering soil, sand, pebbles or other debris on top of part or all of the location member(s), and/or by digging a trench in the ground and burying part or all of the location member(s) in the trench. Preferably the location member(s) extend beyond the body of the SCR when the roll is viewed in plan from above the roll. When the SCR is part of an assembly of SCRs, as further described below, the location member can be used to secure the adjacent SCRs together. When the SCR is used to protect a drain, as further described below, the location member covers the horizontal surface of the drain.

Preferably the location member is in the form of a sheet. The location member is preferably composed of the same material and/or is an extension of the outflow member. However, it may for example comprise an unperforated polymeric film, or a different sheet material having apertures therethrough. Especially when the location member comprises an apertured polymeric sheet material, it preferably also includes a filter which extends over at least part, preferably substantially all, of the location member. The filter can provide at least part, for example all, of the upper surface of the location member, and/or part or all of the filter can be sandwiched between a lower apertured sheet material and an upper apertured sheet material. Especially when the SCR is to be placed on a hard surface (e.g. concrete or asphalt), the location member preferably also includes a filter member which provides at least part of the bottom surface of the location member. The filter member helps to maintain the location member in contact with the underlying surface. The filter on the lower surface of the location member can be as defined above for the outflow filter; for example it can be composed of the same material as the outflow filter.

The location member can include one or more weights, for example around the periphery of the location member, and/or one or more weights, e.g. sandbags, can be placed on the location member after the SCR has been put in place. This helps to secure the SCR in place, and is especially useful when the SCR is being used to control the flow of sediment-bearing liquid into a drain.

Assemblies of SCRs

Two or more SCRs can be joined together end-to-end to form a longitudinally extended SCR. The joints between the SCRs are preferably such that sediment collection takes place at the joints (as well as between them). The joints can for example be made by butting the two SCRs together and joining them by mechanical means, e.g. hooks, ties, tapes, wires or clamps, which optionally are water- impermeable; and/or by means of a tubular C-shaped bridging member which fits inside each of the SCRs; and/or by melt-bonding and/or by adhesives, though this is often inconvenient in the field. When a polymeric bridging member is used, it can be apertured or non-apertured, and can for example be prepared by a tubular extrusion process, or by rolling up a flat sheet of polymeric material, e.g. a sheet material similar to or identical with that used for the threshold and/or outflow member. In one preferred embodiment, a tubular C-shaped apertured bridging member is secured within one end of each SCR, so that it can be fitted into the open end of an adjacent SCR. When the SCRs are to be joined at an angle to each other, the end of each roll can be trimmed to the desired angle and/or an angular tubular bridging member can be used. Alternatively, the SCR itself can be constructed to have an angle in it. Angles can be made in the middle of an SCR by cutting a transverse slit in the locating member (if present) and then bending the tubular section at the slit.

Alternatively or additionally, two or more, e.g. six or eight, SCRs can be joined together side-by-side, for example so that there are multiple SCRs in one or two directions. Such assemblies can include reinforcing members. The resulting assembly can be placed on the ground with the axes of the SCRs generally horizontal or at an angle to the horizontal, e.g. generally vertical. Such assemblies are particularly useful when a high volume of sediment-containing liquid is anticipated, or when the objective is to prevent existing masses of sedimentary material from being washed away. All the SCRs can be of the same length, or they can be of different lengths. For example, they can be staggered regularly or irregularly to form a stepped assembly. A multiplicity of such stepped assemblies can for example be placed around an existing land mass, with the axes of the SCRs as an angle to the horizontal, often with the longest SCRs closest to the existing land mass, and then joined together, thus forming a type of retaining wall, as further described below.

As part of a manufacturing procedure, such assemblies can be for example made by joining the SCRs to each other by melt-bonding, and/or by adhesives, and/or by mechanical means, for example through location members and/or by a sheet of apertured material wrapped around the assembly. In the field, the SCRs (or manufactured assemblies of SCRs) can for example be joined together by mechanical means, e.g. hooks, ties, tapes, wires or clamps, and/or by melt bonding, and/or by adhesives, though the use of melt-bonding and adhesives is often inconvenient in the field.

Use of SCRs to Stabilize Existing Land Masses

One valuable use of the SCRs is to stabilize an existing land mass, e.g. a slope, a gully, a beach, or the bank of a lake, river or canal. For this use, it is preferred to use an assembly comprising a multiplicity of SCRs which are secured together and are installed with their axes at a substantial angle to the horizontal, e.g. 30 to 90°, for example so as to match the slope of the land mass to be stabilized.

Sometimes, it will be convenient to use a manufacturing process to secure together a relatively small number SCRs, e.g. 4 to 20 SCRs, to provide an assembly which can be transported to the installation site, and then to secure a plurality of such assemblies together at the site. The assemblies can be the same or different, and individual SCRs or smaller assemblies can also be used to provide a desired final configuration. The bottoms and/or tops of adjacent SCRs can be stepped, and can be at a right angle or other selected angle to the axes of the SCRs, in order to fit to the terrain on which the SCRs are to be placed, and/or to provide a desired upper contour.

After the SCRs have been put in place, they can be secured to suitable restraints which are embedded in the land mass which is to be stabilized, and/or at least some of the SCCs are then filled with soil to give the assembly greater weight, strength and rigidity, and the ability to support plant life.

Use of SCRs to Protect Drains

An SCR having a location member can be used to control the entry of debris and sediment into drains, particularly roadside drains to which there is access through an opening in the curb and which have a rear portion which is unobstructed at the road level but is covered by the sidewalk. The drain may also have an exposed front portion set in the roadway and covered by a heavy grate. The SCR is placed over the opening in the curb. Preferably, the SCR is long enough to be supported by the curb at each end. The SCC may have a diameter such that its top is also supported by the sidewalk. If the SCR substantially covers the opening in the curb, the top section of the SCR is preferably free of filter material, so that, if necessary, excess sediment-bearing liquid can flow relatively unimpeded into the drain. The location member extends into the roadway, and if there is a grate in the roadway, over the grate. When the location member extends over the grate, it is longer than is required for other uses, for example 3 to 6 times the diameter of the SCC. For this use, the location member preferably comprises two overlapping layers of apertured polymeric sheet material having relatively large apertures therein, and, sandwiched between the overlapping layers, a layer of filter material having relatively small apertures therein.

Preparation of SCRs

The SCRs of the invention can be prepared in any convenient way. The method of the third aspect of the invention is one satisfactory method for preparing SCRs in which the threshold and outflow members comprise overlapping layers of a single piece of apertured sheet material. The method can also provide a location member which is part of the same piece of the apertured sheet material.

In a particular example of this method, a piece of high-density polyethylene netting about 45 in. (1.15 m.) long is cut from the roll of the netting about 60 in. (1.5 m.) wide and placed on a flat table. The polymeric strands and the apertures in the netting are as shown in Figure 4, with the angle Θ being about 75°, a being about 0.062 in. (1.6 mm), x being about 0.225 in (5.7 mm), and y being about 0.215 in. (5.5 mm)) One of the 60 in. (1.5 m) edges is inserted into a slot cut into a mandrel which has a diameter of about 5 in. (125 mm) and a length a little over 60 in. (1.5 m). The mandrel is rotated, keeping the netting tightly wrapped around the mandrel, until the netting overlaps. An ultrasonic weld head is used to melt bond the overlapping layers along the line of the first overlap. One or more pieces of 200 mesh high-density polyethylene filter sheet of selected size are placed at selected positions on the netting which remains on the table (the size and position of the pieces of filter sheet depending on the on the filter(s) desired in the product), and are melt-bonded to the netting. The mandrel is again rotated, keeping the netting (and bonded filter material) tightly wrapped around the mandrel, until the netting again overlaps. The newly overlapping layers are melt-bonded together. The remaining 5 in. (125 mm) of netting still on the table provides the location member. Tubular sleeves having a length of about 10 in. (0.25 m) and a diameter slightly less than the inner diameter of the tube are prepared from high-density polyethylene sheet without apertures or from the netting material. The sleeves can be inserted into the ends of the roll so that two or more SCRs can be joined together in a line.

The Drawings

Referring now to the drawings, in which the same reference numerals are used to denote the same or similar components, Figures 1, 2, 3 and 7 show different SCRs. In each of Figures 1, 2, 3 and 7, netting material 1 and filter material 2 have been rolled up and secured together, e.g. melt-bonded together, at locations 3, leaving flap 4 of the netting extending as a location member. In Figures 1-3, overlapping sections 11a and 11b (and in Figure 2 also overlapping section 11c) of the netting material 1 provide the outflow member, and have outflow filter 21 sandwiched between them; and overlapping sections 12a and 12b provide the threshold member, and in Figures 2 and 3 (but not in Figure 1) have threshold filter 22 sandwiched between them. In Figure 2, the threshold filter extends to an upper level which is below the upper level of the outflow filter, thus leaving an upper filter-free section. In Figure 3, the outflow and threshold filters form a continuous filter around the circumference of the sediment SCR. In Figure 7, the extent of the overlap is limited to that needed to secure the overlapped areas together, and the filter 21 extends over, and forms the upper surface of, the location member. In each of Figures 1-3 and 7, SCC 6 is enclosed by the threshold and outflow members.

Figure 4 is a plan view of an example of the polymeric netting that can be used for the threshold and outflow members in the present invention. The netting has been prepared by extrusion in the machine direction shown by the vertical arrow in Figure 4. The thickness of the polymeric strands is designated a; the acute angle of the parallelogrammatic apertures is designated Θ; the major dimension parallel to the polymeric strands is designated x; and the minor dimension parallel to the polymeric strands is designated y.

Figures 5 and 6 are plan and side views of an assembly made up of six SCRs as shown in Figure 3, but of different lengths. The SCRs are joined together by melt-bonding respective location members 4A-4F to the adjacent SCR at locations 7A-7F.

In Figures 8-22, a substantially flat precursor comprises netting 1 and filter material 2 extending over all (Figures 8-9) or a selected part (Figures 11-12, 14-15, 17-18 and 20-21) of the netting. The precursor can be rolled up, in the direction shown by the arrow in Figures 8, 11, 14, 17 and 20, and the resulting overlapped portions of the precursor secured together at locations 3 to provide SCC 6 and location member 4. In Figure 20, the precursor also includes an upper layer of netting 41 which forms the top surface of the location member in the resulting SCR shown in Figure 22, which is particularly suitable for use in controlling the flow of sediment-bearing liquid into a drain.

In Figure 23, a slope 232 of a land mass is stabilized by an assembly 233 of SCRs. The bottoms of the SCRs are placed in a trench 231 which has been excavated at the bottom of the slope.

In Figures 24 and 25, an SCR of the type shown in Figure 22 is used to control the flow of sediment-bearing water into a drain 241 set into a road 242 which is bordered by sidewalk 243 having a curb 244. The drain is covered by grate 245 (whose periphery is shown by the broken line in Figure 25), except for a rear portion underneath the sidewalk, to which there is access through an opening in the curb. The SCC 6 covers the opening in the curb and contacts adjacent portions of the curb. The location member 4 covers the grate 245 and extends over adjacent portions of the road.

In Figure 26, a substantially flat precursor comprises netting 1 and filter material 2 extending over a selected part of the netting, and extending from the netting. The precursor can be rolled up, in the direction shown by the arrow, and the resulting overlapped portions of the precursor secured together at locations 3 to provide SCC 6 and location member 4, as shown in Figure 27.

Figures 28 and 29 show an SCR similar to that shown in Figure 27, but having a C-shaped apertured bridge member 9 secured thereto.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A sediment control roll (SCR) which comprises

1) an elongate threshold member having a multiplicity of relatively large threshold apertures therethrough, each of the threshold apertures having an area of 0.01 to 1.0 in.² (6.5 to 650 mm²);

2) an elongate outflow member having a multiplicity of relatively large outflow apertures therethrough, each of the outflow apertures having an area of 0.01 to 1.0 in.² (6.5 to 650 mm²);

3) an elongate outflow filter which

(i) is supported by the outflow memo, and

(ii) has a multiplicity of relatively small filter apertures therethrough;

the SCR comprising a substantially hollow, elongate sediment collection chamber (SCC) which lies between the threshold member and the outflow member.

2. An SCR according to claim 1 wherein the threshold and outflow members are provided by a single piece of an apertured polymeric sheet which has been shaped into a generally tubular configuration comprising overlapping layers of the apertured polymeric sheet.

3. An SCR according to claim 2 wherein the layers overlap over a generally rectangular area which extends over the length of the tubular configuration and is 0.5-3 in. (12.5-75 mm) wide.

4. An SCR according to claim 2 wherein the layers overlap over a generally rectangular area which extends over the length of the tubular configuration and is such that at least 20% of the outflow filter is sandwiched between the overlapping layers.

5. An SCR according to any one of the preceding claims wherein each of the apertures in the threshold and outflow members has an area of 0.02 to 0.25 in.² (13 to 160 mm²) and the open area of each of the threshold and outflow members is 25 to 65% of the total area of the exposed surface.

6. An SCR according to any one of claims 1 to 6 wherein the outflow filter has a mesh size of 80 to 600 micron and a substantially uniform thickness of less than 0.5 in. (12.5 mm).

7. An SCR according to any one of the preceding claims which, when subjected to a test which consists of

(i) completely immersing the SCR in water for 0.5 hour,

(ii) removing the SCR from the water,

(iii) placing the SCR on a horizontal apertured surface, and

(iv) leaving the SCR to drain for 0.5 hour in still air at 20°C,

has a weight after the test which is not more than 1.1 times its weight before the test.

8. An SCR according to any one of the preceding claims which, when subjected to a test in which clean water is directed towards the SCR at right angles to the threshold member, is capable of passing at least 10 gallons of water, but not more than 40 gallons of water, per square foot per minute (at least 0.4 m^3 of water, but not more than 1.6 m^3 of water per m^2 per minute) of the frontal area of the threshold member, and the volumes of water entering and leaving any particular length of the SCR are substantially the same.

9. An SCR according to any one of the preceding claims which, when subjected at 70°F. (21°C) to a test in which a weight of 200 lb. (90 kg) is applied uniformly to a 1 foot (0.3 m) long section of the top of the SCR for 20 seconds, and is then removed, the height of the SCR, in the section underneath the weight, decreases by at least 60% before the weight is removed, and recovers to at least 75% of its original height within one hour of the weight being removed.

10. An SCR according to any one of the preceding claims which comprises a location member extending from the outflow member.

11. An SCR according to claim 10 wherein the threshold member, the outflow member and the location member are different parts of a single piece of an apertured polymeric sheet.

12. An SCR according to claim 11 wherein the threshold member, the outflow member and the location member are different parts of a single piece of melt-extruded polymeric netting composed of a plurality of polymeric strands;

the outflow filter (i) is secured to the outflow member, and (ii) has a mesh size of 80 to 600 micron.

13. An SCR according to claim 11 or 12 wherein the outflow filter extends over only a lower section of the outflow member, the lower section extending from the bottom of the

outflow member to an upper level, the upper level being at least 80% of the height of the SCR.

14. A method of collecting sediment from a flowing stream of a sediment-bearing liquid which comprises passing the flowing stream through an SCR as claimed in any one of the preceding claims.

15. A method according to claim 14 wherein the flowing stream is run-off from a construction site.

16. A method according to claim 14 wherein the SCR

(a) is placed over an opening in a curb adjacent to a drain, and

(b) includes a location member which includes a filter,

whereby sediment-bearing liquid flowing towards the drain passes through the location member or the SCC before entering the drain.

17. A method according to claim 14 wherein the flowing stream comes from an existing land mass; a multiplicity of SCR's are secured together and are installed with the axes at an angle of 30° to 90° to the horizontal; and the method prevents or reduces removal of sediment from the land mass.

18. A method of making an SCR as claimed in any one of claims 1 to 13, the method comprising

(A) providing a precursor for the SCR, the precursor comprising (i) an apertured sheet material having the relatively large apertures therethrough, and (ii) a sheet of filter material which has the relatively small apertures therethrough and which is secured to part or all of the apertured sheet material;

(B) shaping the precursor to provide a generally tubular body (a) which comprises first and second parts of the apertured sheet material which overlap each other, and (b) in which at least part of the filter material is secured to at least part of an interior surface of the tubular body; and

(C) securing the overlapping first and second parts of the apertured sheet material together.

19. A method according to claim 18 wherein a portion of the apertured sheet material having filter material secured thereto extends tangentially from tubular body, thus providing a location member.

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20. A precursor suitable for use in a method as defined in claim 18 or 19, the precursor comprising

(1) a substantially rectangular apertured sheet material having the relatively large apertures therethrough, and

(2) a substantially rectangular sheet of filter material which has the relatively small apertures therethrough and which is secured to the apertured sheet material.

21. A precursor according to claim 20 which comprises a substantially rectangular apertured sheet material and a substantially rectangular sheet of filter material secured thereto, the sheet of filter material being secured to the sheet of apertured sheet material so that two of the four edges are substantially coincident and a portion of the sheet of filter material extends beyond the apertured sheet material.

FIG. 1

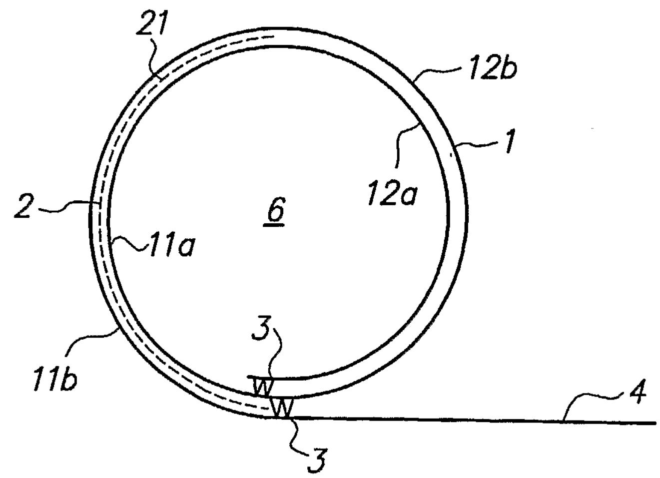


FIG. 2

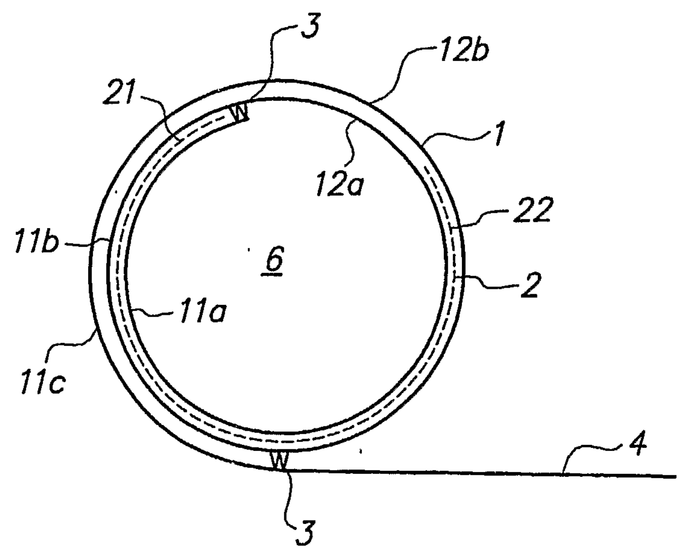


FIG. 3

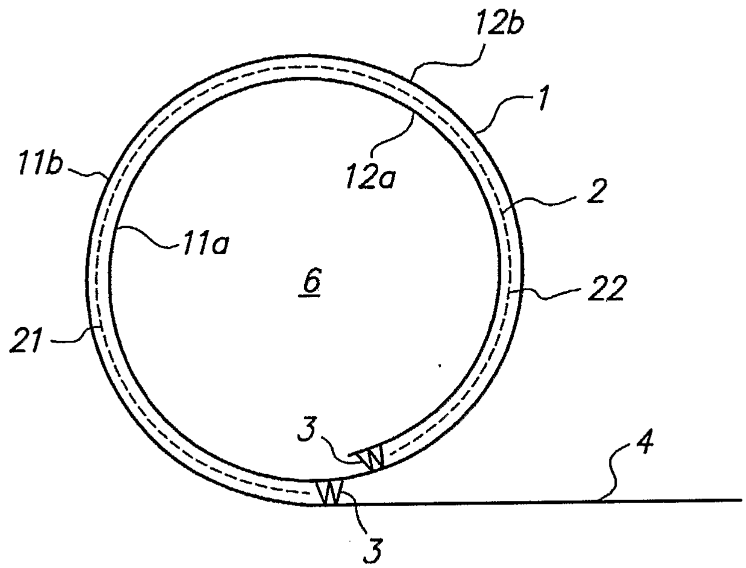


FIG. 4

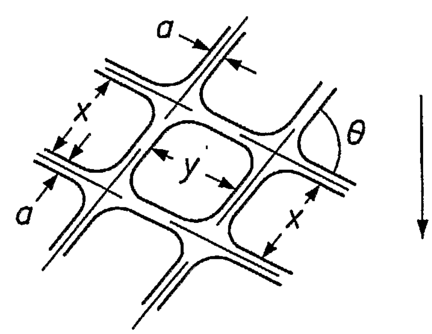
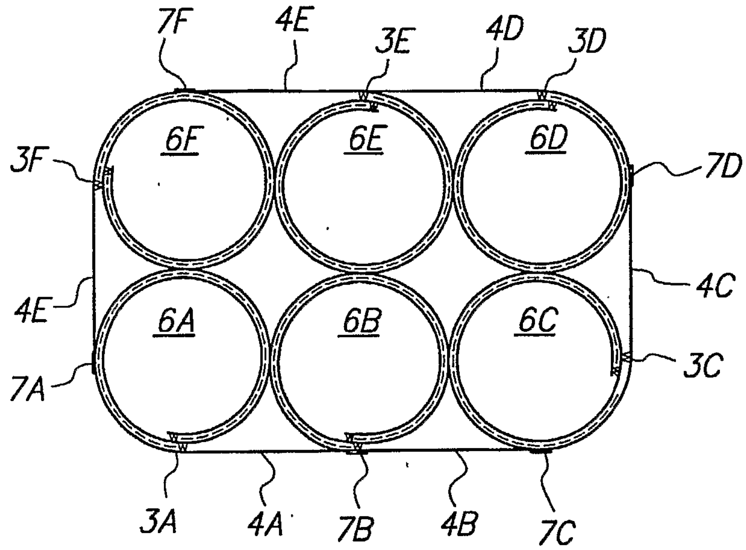


FIG. 5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3E
4D
3D
6F
6E
6D
3F
7D
4E
4C
6A
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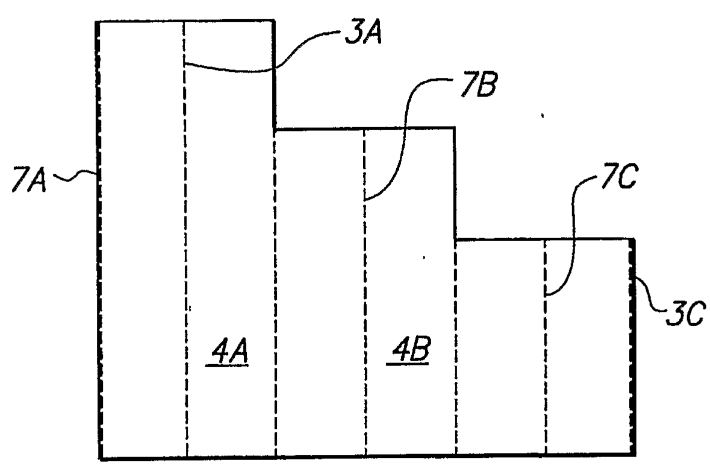
7B
4B
7C

FIG. 6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7B
7A
7C
3C
4A
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FIG. 7

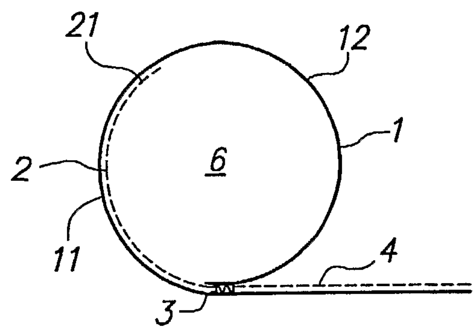

FIG. 8

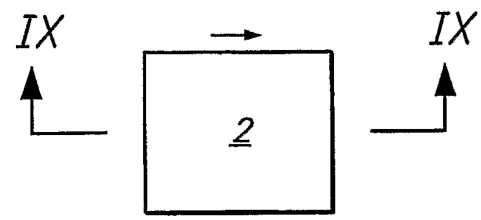

FIG. 9

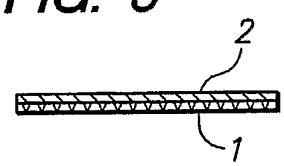

FIG. 10

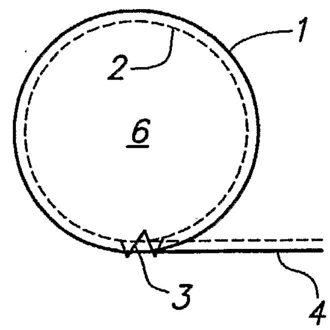

FIG. 11

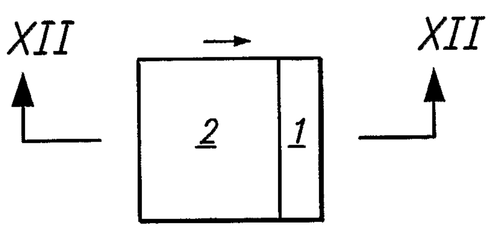

FIG. 12

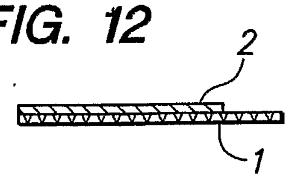

FIG. 13

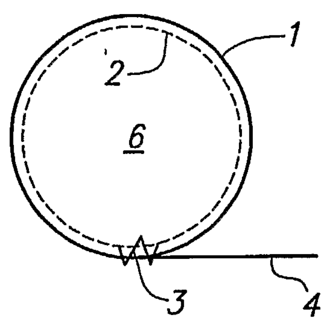

FIG. 14

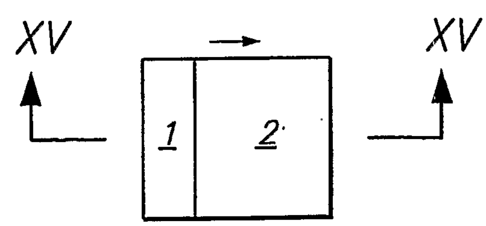

FIG. 15

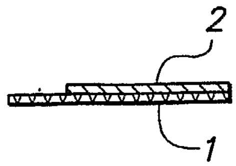

FIG. 16

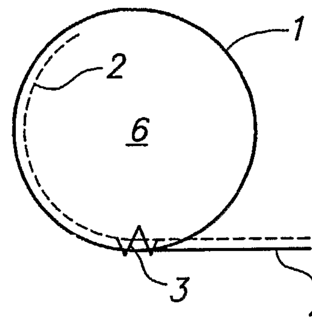

FIG. 17

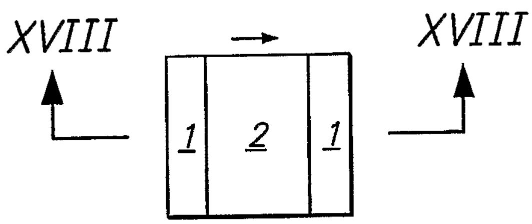

FIG. 18

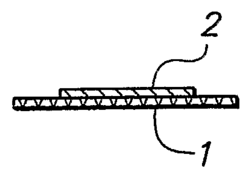

FIG. 19

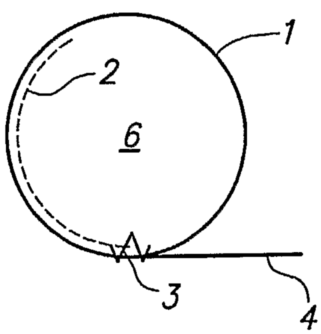

FIG. 20

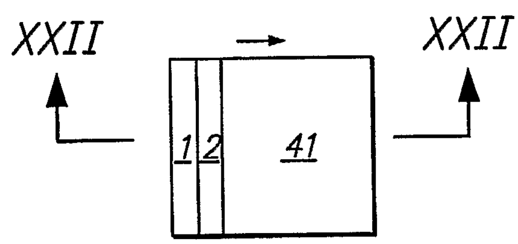

FIG. 21

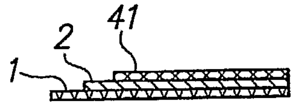

FIG. 22

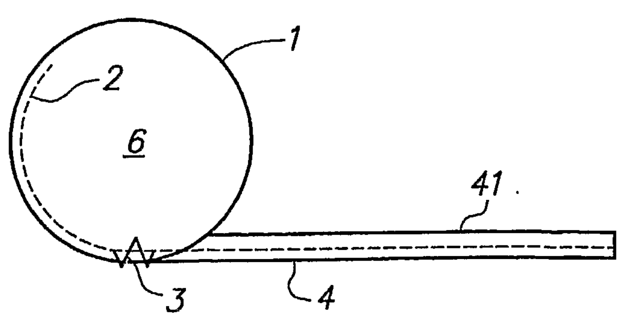

FIG. 23

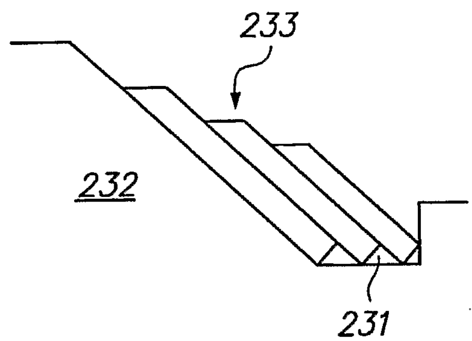

FIG. 24

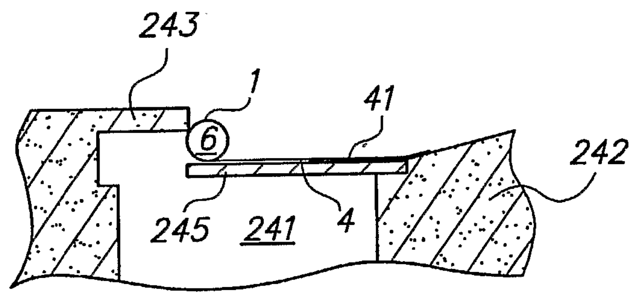

FIG. 25

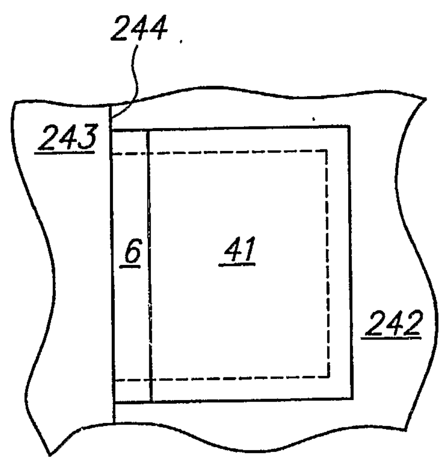

FIG. 26

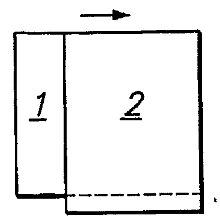

FIG. 27

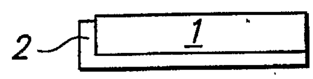

FIG. 28

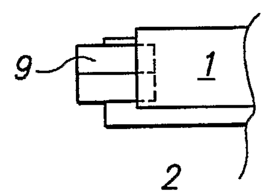

FIG. 29