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(54) **Block mattress for the protection of slopes, berms and the like.**

(57) A block mattress for the protection of slopes, berms, and the like, comprising a water-permeable fabric ply (1) with a number of blocks (2,3) of a relatively heavy and hard material, such as concrete, fastened on both sides of the fabric ply. Two blocks (2,3) on either side of the fabric ply (1), arranged opposite each other, can be interconnected by a part having a relatively small transverse section and extending through the fabric ply (1), for instance a pin (6), fixed in both blocks (2,3). Preferably, the blocks (2,3) have a shape tapering off constrictingly from the fabric ply (1) and, in top plan view, a rounded contour. In this manner, an extremely flexible block mattress can be obtained, which, by pressing the blocks (2,3) on the bottom side of the fabric ply (1) into the underground, can be anchored reliably and which has relatively large open spaces for promoting a luxuriant, natural plant vegetation between the blocks (2,3) on the top of the fabric ply (1).

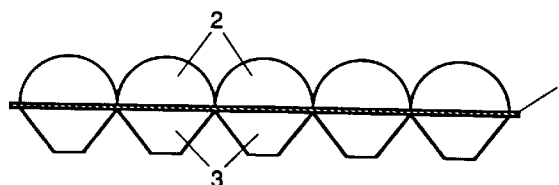


FIG. 2

This invention relates to a block mattress for the protection of slopes, berms, and the like, comprising a water-permeable fabric ply having attached thereto a number of blocks of a relatively heavy and hard material, such as concrete.

Known block mattresses of the above-mentioned type consist of a fabric ply that is laid on the underground to be protected or reinforced, in particular an underground subject to erosion through water hammer. The fabric ply is permeable to water, but prevents soil located under the fabric ply from washing away. For instance for retaining the fabric ply in position, a large number of blocks are arranged on the fabric ply, disposed so as to be more or less in abutment with each other. To promote a natural vegetation, the blocks are provided with continuous openings, which may or may not be filled with soils.

The object of the present invention is to improve such a block mattress so as to obtain a better protection and reinforcement of the underground, while the guarantee that the block mattress remains in position is increased.

According to the invention, this is realized in a block mattress of the type referred to in the preamble in that blocks are arranged on both sides of the fabric ply. Through this measure, when the block mattress is being laid, the blocks then located under the fabric ply will penetrate into the underground and thus compact that underground. At the same time, the fact that the blocks penetrate into the ground means a better anchoring of the block mattress, which is advantageous in particular if the block mattress is laid on an inclining underground. Special anchorage cables and fastening means at the top edge of the block mattress as used with known block mattresses, smooth on the bottom side, can nearly always be omitted.

The improved anchoring also results from the fact that each block on the bottom side of the block mattress is independently supported on the underground, which is not always guaranteed with the known mattresses, having blocks on the fabric ply only, because at the location of a hole or other recess in the underground, the continuous fabric ply may prevent a block from lowering therein until it abuts on the underground, as a consequence of which there is a chance that the fabric ply is damaged and hence the soil to be retained is washed away. Consequently, the improved anchoring has the added benefit of a smaller chance of damage.

The number of blocks on the top and bottom sides of the fabric ply may be mutually different and vary depending on the intended use of the block mattress. For instance, in the case of a relatively dense underground, a smaller number of blocks may be provided on the bottom side of the fabric ply than on the top side, while in the case of a soft underground or hardly

any wave action, if at all, more blocks may be present on the bottom side than on the top side of the fabric ply.

For interconnecting the blocks and the fabric ply, it is preferred that opposite a block on one side of the fabric ply a counter block is located on the other side. This embodiment is also advantageous when a lower block is pressed into an underground in view of the smaller chance of damage to the fabric ply then involved, in particular in the case of a relatively hard underground, while it is further preferred that opposite each block on one side of the fabric ply a block is located on the other side. In this connection, preferably the same number of blocks are present on both sides of the fabric ply, although it is also possible that one block on one side is located opposite two or more blocks on the other side of the fabric ply, because in the present invention it is possible to adapt the shape and dimensions of a block optimally to the circumstances to be considered on that side of the fabric ply where the block in question is located.

In accordance with a further embodiment of the invention, for attaching a block to the fabric ply, it is preferred that two blocks located opposite each other relative to the fabric ply be interconnected by means of a coupling part, receding on all sides relative to the adjoining faces of the blocks and extending through the fabric ply.

In this connection, it is further preferred that the coupling part is a pin, for instance manufactured from synthetic material and having lateral protrusions ensuring a reliable connection with a block, prefabricated or manufactured round the pin. Another possibility is that the coupling part consists of a constricted center portion, forming one piece with the two blocks. In this last embodiment, the fabric ply can be designed so that it can be widened locally for a block to be passed through, which widening is no longer possible if that block is surrounded by other blocks.

In accordance with a further, particularly preferred embodiment of the invention, it is provided that the blocks are solid and are arranged in such a pattern that open spaces are present between the blocks. Through these measures, the natural vegetation of the block mattress can be considerably promoted, particularly if, in top plan view, the blocks have such a contour that in a pattern wherein all blocks are in mutual contact, only a point contact or relatively short line contact is established between two blocks, so that relatively large open spaces remain present between the blocks. Due to the point contact or relatively short line contact, the open spaces virtually communicate with each other, unlike blocks that practically abut against each other, having local holes or interruptions entirely surrounded by portions of the block. Because, in accordance with

the invention, the open spaces virtually communicate with each other, the plants rooting in the open spaces may form an intertwined root network and hence grow together more luxuriantly and with a better resistance to being washed away than in the case of isolated clumps of plants.

To enhance penetration into the underground and hence compacting thereof, as well as a strong anchoring of the block mattress, in accordance with a further embodiment of the invention, it is preferred that the blocks on the bottom side of the fabric ply have a shape tapering off from that ply, while it is particularly preferred that the blocks have the shape of a truncated cone or pyramid.

Preferably, the blocks on the top of the fabric ply have a rounded or otherwise hydraulically adapted, i.e. a wave-breaking or wave-braking shape. If much open space between the blocks is considered desirable for promoting plant vegetation, hemispherical blocks are preferred.

If a block mattress is used with blocks on either side of the fabric ply, which blocks have a shape receding from the fabric ply, a block mattress is obtained which is flexible on all sides, i.e., a block mattress capable of bending from the plane in all directions and hence of adapting itself optimally to the profile of the underground without involving danger of damage to the fabric ply as a consequence of blocks on the bottom side of the fabric ply being unable to find sufficient support, if at all, at the location of holes and the like.

If ample possibilities for plant vegetation between the blocks are desired, hemispherical blocks are preferred. In this case, a relatively dense stacking can nevertheless be obtained if, in accordance with a further embodiment of the invention, the blocks on one side of the fabric ply, touching each other, are arranged in a checkered pattern. Such pattern has the further advantage that if the blocks under and above the fabric ply have the same pattern, two or more block mattresses can be laid on top of each other, allowing the blocks under the fabric ply of the superjacent mattress to engage, more or less nestingly, in the spaces between the blocks on the fabric ply of the subjacent mattress.

In terms of wave-breaking and wave-braking action, a better, i.e. a more closed pattern is obtained if the blocks on one side of the fabric ply, touching each other, are arranged in a honeycomb pattern, which even permits a practically entirely closed pattern to be obtained if the blocks have the shape of a truncated pyramid with a rectangular base. Such an embodiment of the block mattress may also be preferred if the mattress should be capable of taking up a higher load, for instance the weight of a vehicle driving over it.

Of course, it is also possible to construct a block mattress with the blocks partly in an entirely or almost entirely closed pattern, for instance a portion of the mattress exposed to wave action, and partly in a relatively open pattern, for instance a portion of the mattress not subject to wave action.

The block mattress according to the invention will be further discussed and explained hereinafter, by way of example only, with reference to the embodiments schematically shown in the accompanying drawings. In these drawings:

Fig. 1 is a top plan view of an embodiment of a block mattress according to the invention;

Fig. 2 is a side view of the block mattress according to Fig. 1;

Fig. 3 is a bottom view of the block mattress according to Fig. 2;

Fig. 4 is an elevational and partly sectional view of an element used in the block mattress according to Fig. 2, to an enlarged scale;

Fig. 5 is a view similar manner to Fig. 4, of a modified embodiment of the element;

Fig. 6 is a side view of another embodiment of an element to be used in a block mattress;

Fig. 7 is a top plan view of the element according to Fig. 6;

Fig. 8 is a bottom view of a portion of a further embodiment of a block mattress according to the invention; and

Fig. 9 is a side view of the block mattress according to Fig. 8.

The block mattress shown in top plan view in Fig. 1 comprises a water-permeable fabric ply 1, for instance manufactured from synthetic fibers or strips, there being provided on the top side of the fabric ply a large number of hemispherical blocks 2 and on the bottom side, as shown in Figs 2 and 3, a large number of blocks 3 having the shape of a truncated cone whose base is placed against the fabric ply 1.

In the embodiment shown, the faces of the blocks 2 and 3 facing each other have an identical surface, the same number of blocks having been provided of both types of blocks in a checkered pattern on both sides of the mattress. The identical faces of the blocks 2 and 3 facing each other overlap, the connection between the fabric ply 1 and the blocks 2 and 3 being established by means of a coupling part extending from a block 2 through the fabric ply 1 to a block 3. This coupling part will be discussed in more detail in the discussion of Figs 4 and 5.

In such embodiment of the block mattress, more than 20% of the surface of the fabric ply 1 remains uncovered, which ensures proper conditions for a luxuriant plant vegetation when a block mattress is laid on an underground to be protected and/or reinforced. Because the blocks 2 are in mutual contact only through

points, the root systems of the plants growing in the open spaces may intertwine to form a continuous field, as it were, resulting in a proper adhesion of the roots, partly extending through the fabric ply 1, so that the danger of the plants being washed away is small.

For laying a prefabricated block mattress, a block mattress in rolled-up form may be started from, which can readily be realized through the shape of the blocks 2 and 3 on either side of the fabric ply 1, because the block mattress shown is particularly flexible and can be wound up into a rather compact roll. When the mattress is unrolled during laying, the blocks 3, having the shape of truncated cones, contact the underground and can be pressed into the underground relatively easily, partly in view of their shape. This does not only mean that the block mattress is properly anchored relative to the underground, but also that that underground is compacted and hence becomes stronger. The penetration into the underground is arrested by the fabric ply 1 superficially contacting the underground. The anchoring in the underground is such that even when the mattress is laid on a strongly inclining underground, in most cases the provision of fixing means for retaining the block mattress in position can be omitted. After the block mattress has been laid, soil can be dumped on the top side thereof, i.e. round and, if necessary, on the blocks 2. Accordingly, due to the hemispherical shape of the blocks 2, the open surface will increase, creating even better conditions for a natural plant vegetation on the block mattress, for instance because the roots of the various plants may now intertwine even better and a proper adhesion of the plants to the underground can be established in horizontal as well as in vertical direction.

A further advantage of the block mattress shown is that it is particularly flexible. Should the underground be uneven or subside locally after the block mattress has been laid, such block mattress has such adapting possibilities that this uneven surface can be followed within very wide limits without any trouble. Obviously, this is also advantageous with regard to a proper anchoring of the block mattress relative to the underground. Moreover, more or less floating blocks 3 are prevented from loading the fabric ply 1, so that the danger of damage to the fabric ply 1 is reduced as well.

For fixing the blocks 2 and 3 onto the fabric ply 1, these blocks may be interconnected by means of a coupling part extending through the fabric ply 1. In the exemplary embodiment according to Fig. 4, this coupling part has the shape of a center portion 4 forming one whole with both the block 2 and the block 3', which center portion has a transverse section smaller than the faces of the blocks 2 and 3' facing each other

such that a central, constricted section is formed. Such an element may be manufactured from concrete, but in that case a reinforcement should be present at least in section 4, extending into the blocks 2 and 3'. The element shown in Fig. 4 is of a one-piece construction and is manufactured from synthetic material. A further possibility is to manufacture the block 3', the section 4 and an extension thereof in the block 2 in one piece from synthetic material, and the other section of block 2 from concrete. To enable such element to be connected with the fabric ply 1, the block 3' comprises a smaller base than the block 2 and the constituent parts of the fabric ply 1 should be capable of being locally drawn apart thus far, that the block 3' can pass the ply 1. The structure of the fabric ply 1 can be adapted thereto. It is observed that generally, after the element and elements grouped thereabout have been provided, it will no longer be possible to remove an intermediate element from the fabric ply, so that the elements are sufficiently secured in the fabric ply.

Another fastening possibility is shown in Fig. 5. In Fig. 5, each block 2 and 3 comprises a recess 5 in the form of a bore, into which a pin 6 extends, fixedly clamped in the bore through friction between the wall of the bore 5 and protrusions 7 on the pin 6. Of course, it is also possible to cast the pin 6 in one-sidedly when the block 2 or 3 is formed, and to secure it, after passing it through the fabric ply, in the bore of the other block by means of an adhesive material, or by subsequently casting that other block.

Figs 6 and 7 show a further possible embodiment of a block configuration to be connected to a fabric ply, which can for instance be used when a maximally closed surface is desired. Here, two blocks 13 having the shape of a truncated cone are each connected, by means of a coupling part 14, to one block 12, having the shape of a truncated pyramid with a rectangular base and hence a more voluminous shape than two blocks 2 or 3 according to Fig. 5.

In the case where a wave-braking or wave-breaking action is of considerable importance, instead of a checkered pattern, as shown in Fig. 1, a honeycomb pattern can be chosen, as shown in Fig. 8, indicating, in bottom view, a portion of a further embodiment of the block mattress. As may also appear from the side view shown in Fig. 9, the blocks 23 located on the bottom side of the fabric ply 1 have the shape of a truncated pyramid with a hexagonal base. The blocks 22 arranged on the top side of the fabric ply have the shape of a truncated pyramid with a rectangular base so as to cover the entire surface of the fabric ply. The staggered position of the blocks 22, as may appear most clearly from the side view according to Fig. 9, provides this embodiment with the desired improved wave-braking or wave-breaking action.

It is understood that many further modifications and variants are possible within the scope of the invention as laid down in the appending claims. For instance, concrete has been mentioned as material for the blocks; this may also be any other suitable material, while the material of the blocks arranged on the fabric ply may differ from that of the blocks under the fabric ply. Depending on the desired weight, a number of the blocks may optionally be manufactured from a synthetic material and then for instance be provided with a cast-on pin for attaching a block to the other side of the fabric ply. This last will often be manufactured from synthetic fibers. However, any other material is possible as well. The block mattress is not only applicable on an inclining underground, which may or may not be water-limiting, but may also be used for protecting and reinforcing horizontal berms, while in particular the block mattresses with checkered pattern are capable of being stacked without any problem, with or without the insertion of soil filling the residual spaces.

Claims

1. A block mattress for the protection of slopes, berms, and the like, comprising a water-permeable fabric ply having attached thereto a number of blocks of a relatively heavy and hard material, such as concrete, characterized in that blocks are arranged on both sides of the fabric ply.
2. A block mattress according to claim 1, characterized in that at least a number of blocks on one side of the fabric ply are each located opposite at least one block on the other side of the fabric ply.
3. A block mattress according to claim 2, characterized in that each block on one side of the fabric ply is located opposite one block on the other side of the fabric ply.
4. A block mattress according to any one of the preceding claims, characterized in that the same number of blocks are arranged on both sides of the fabric ply.
5. A block mattress according to any one of the preceding claims, characterized in that two blocks located opposite each other relative to the fabric ply are interconnected by means of a coupling part, receding on all sides relative to the adjoining faces of the blocks and extending through the fabric ply.
6. A block mattress according to any one of claims

1-4, characterized in that the coupling part is a pin.

7. A block mattress according to claim 6, characterized in that the pin is manufactured from synthetic material and has lateral protrusions ensuring a reliable connection with a block, prefabricated or manufactured round the pin.
8. A block mattress according to claim 5, characterized in that the coupling part consists of a constricted center portion, forming one piece with the two blocks.
9. A block mattress according to any one of the preceding claims, characterized in that the blocks are solid and are arranged in such a pattern that open spaces are present between the blocks.
10. A block mattress according to claim 9, characterized in that, in top plan view, the blocks have such a contour that in a pattern wherein all blocks are in mutual contact, only a point contact or relatively short line contact is established between two blocks, so that relatively large open spaces remain present between the blocks.
11. A block mattress according to any one of the preceding claims, characterized in that the blocks on the bottom side of the fabric ply have a shape tapering off from said ply, effecting a proper penetration into a soil stratum.
12. A block mattress according to claim 11, characterized in that the blocks have the shape of a truncated cone or pyramid.
13. A block mattress according to any one of the preceding claims, characterized in that the blocks on the top of the fabric ply have a rounded or otherwise hydraulically adapted, i.e. a wave-breaking or wave-braking shape.
14. A block mattress according to claim 13, characterized in that the blocks are hemispherical.
15. A block mattress according to any one of claims 9-14, characterized in that the blocks on one side of the fabric ply, touching each other, are arranged in a checkered pattern.
16. A block mattress according to any one of claims 9-14, characterized in that the blocks on one side of the fabric ply, touching each other, are arranged in a honeycomb pattern.

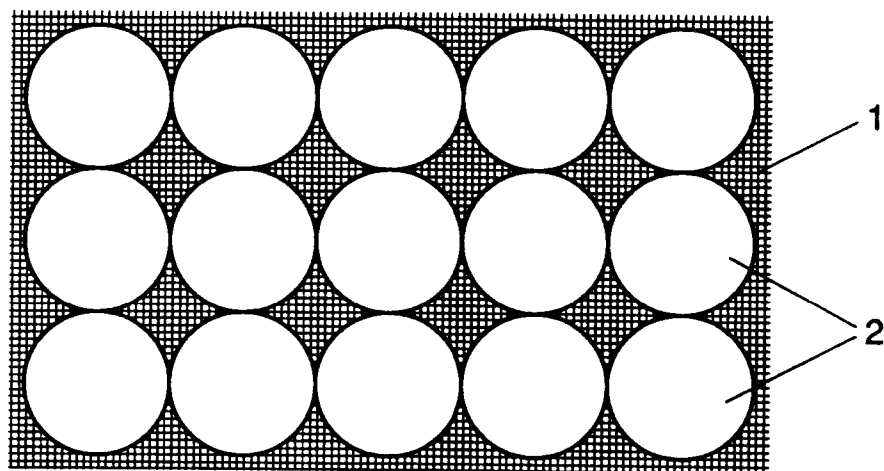


FIG. 1

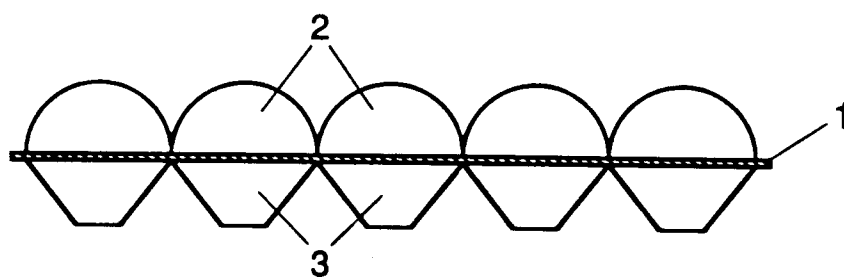


FIG. 2

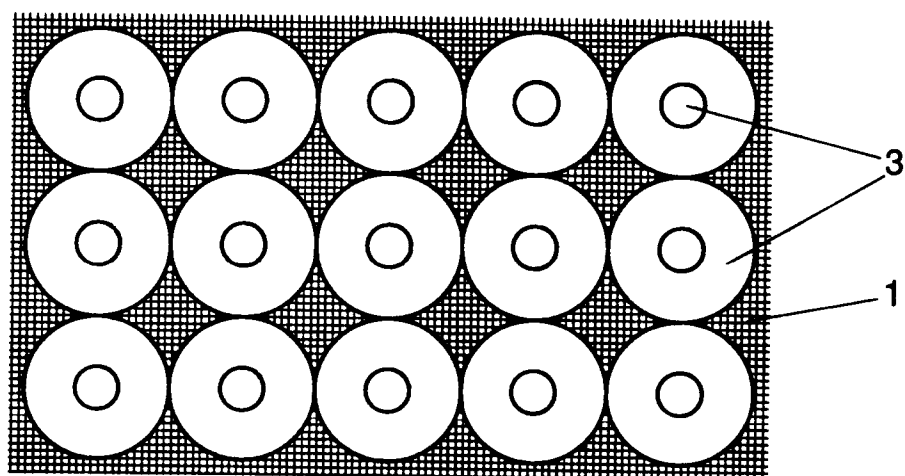


FIG. 3

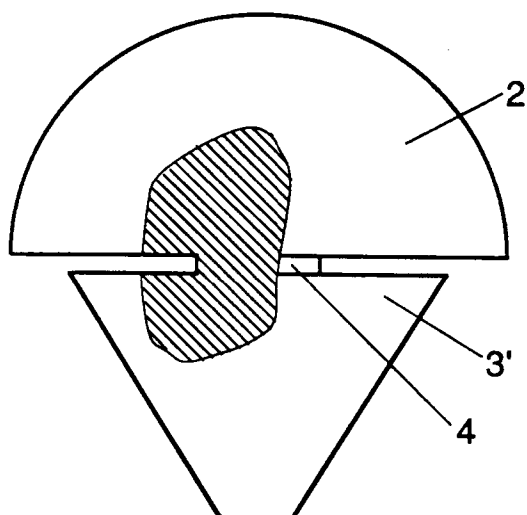


FIG. 4

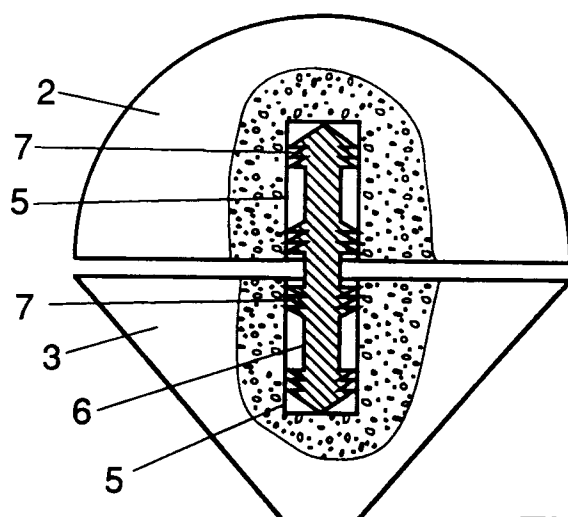


FIG. 5

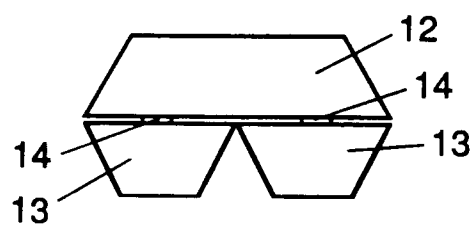


FIG. 6

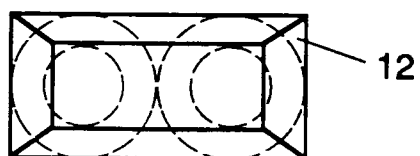


FIG. 7

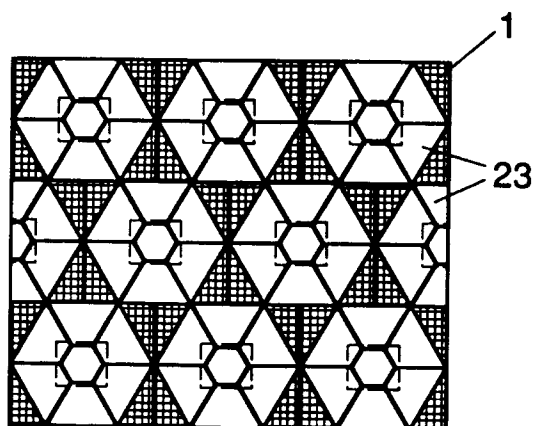


FIG. 8

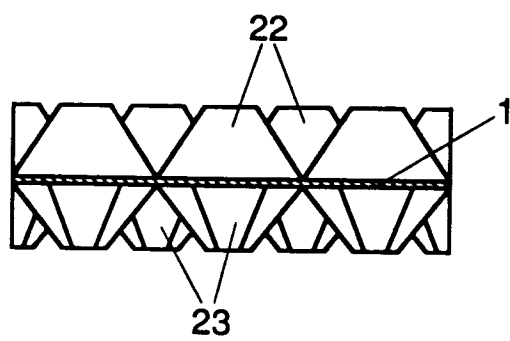


FIG. 9



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 20 0133

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	DE-A-18 13 450 (J. PILAAR) * page 19, paragraph 4 - page 20, paragraph 1; claims 1,10; figure 9 *	1,4	E02B3/12
Y	---	2,3,6,7, 9-11, 13-16	
Y	DE-U-89 06 060 (TEXTEC TEXTIL ENG.) * figure 2 *	2,3	
A	---	12	
Y	FR-A-2 211 952 (MORILLON CORVOL COURBON) * page 2, line 11 - line 24; figures 1,2 *	6,7	
Y	GB-A-2 212 195 (BUKASA) * figures 1,5,11,16 *	9,10,16	
Y	WO-A-89 09854 (C. WATERS) * page 10, line 20 - page 11, line 29 * * page 17, line 13 - line 22; figures 1,B1,B2 *	9,11,13, 14	
Y	EP-A-0 152 232 (UNITED WIRE GROUP) * figure 12 *	9,15	E02B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 March 1994	Examiner Kriekoukis, S
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