

[54] **VERTICAL DRAINAGE SYSTEM**
 [75] Inventors: **Berthold H. Daimler,**
Remscheid-Lennep; Wilhelm
Herveling, Wuppertal-Elberfeld;
Helmut Werner, Elsenfeld; Hans
Stapp, Momlingen, all of Germany

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[73] Assignee: **Akzona Incorporated, Asheville, N.C.**

Primary Examiner—Alfred C. Perham
Attorney—John H. Shurtleff et al.

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[57] **ABSTRACT**

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A vertical drainage system for a basement or other below grade foundation wall having a sealer coat on its outer surface, a filamentary web or sheet composed of a fiber-forming synthetic thermoplastic polymer, preferably in the form of rows of looped amorphous melt-spun and bonded filaments, being laid along the wall between its outer sealer coat and the adjacent earth, and pipe means or the like near the bottom or footing of the wall to drain off water percolating downwardly through the filamentary filter layer.

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 [58] Field of Search..... 52/169, 309;
 161/150; 210/496

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10 Claims, 2 Drawing Figures

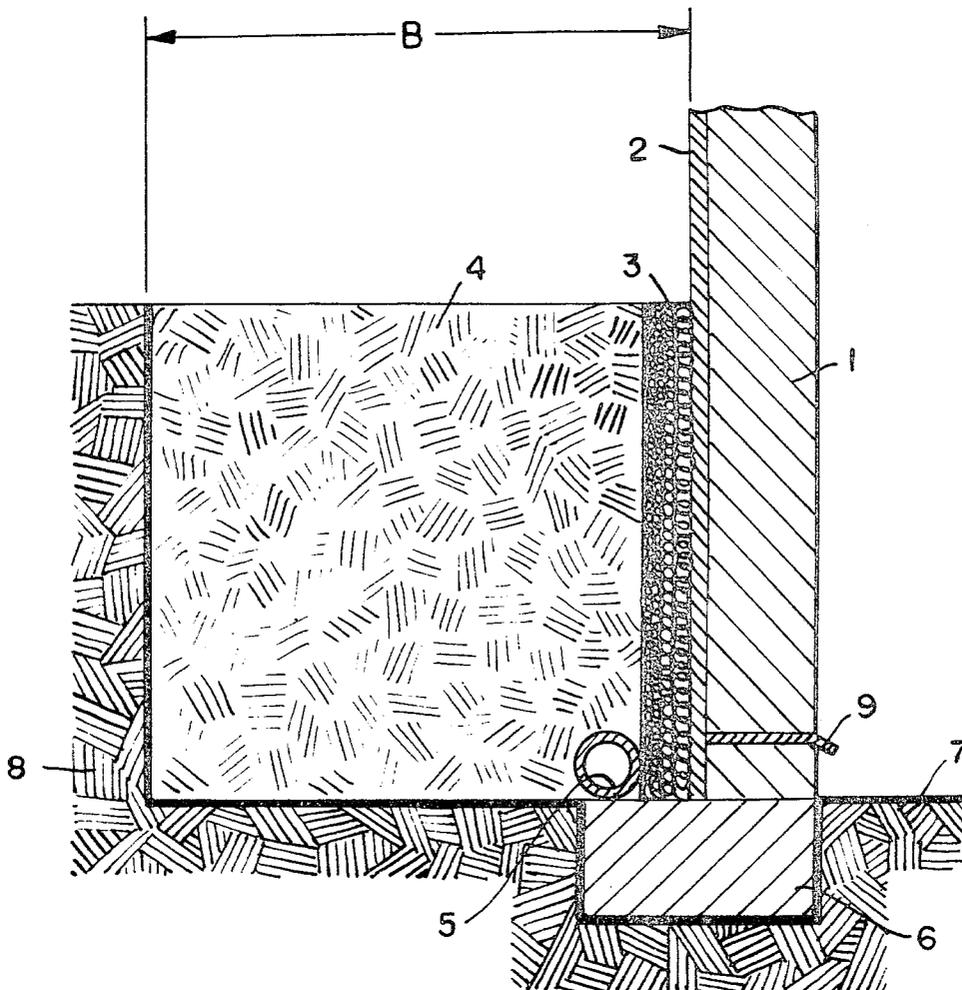


FIG. 1

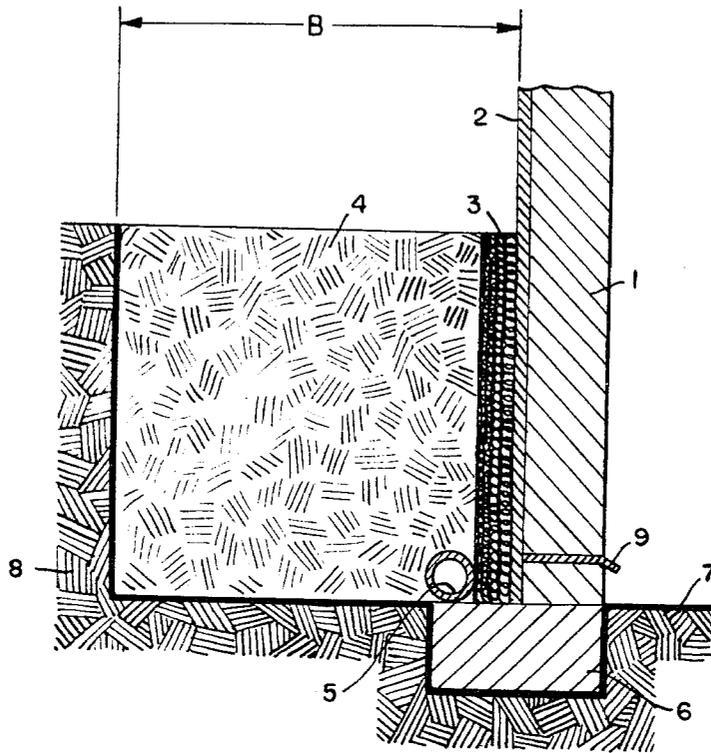
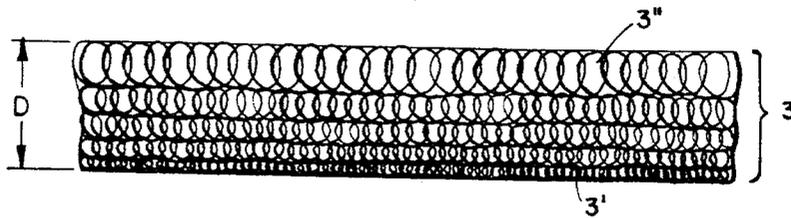


FIG. 2



VERTICAL DRAINAGE SYSTEM

In the construction of buildings, it has been conventional to provide its foundation walls used for basements, cellars or the like with a sealing layer as well as a sealer coat in order to prevent seepage or penetration of water or moisture into the masonry wall of the foundation structure. The water which is blocked or dammed up by such layers or coatings can be referred to as "pressure water." In order to avoid a highly expensive water-impermeable sealing of the wall, i.e., one which must also be able to withstand this pressure water, it has been proposed that a porous filter layer be introduced between the earth and the sealing coat so as to quickly conduct the water off in a vertical direction.

With known vertical drainage systems, the porous filter layer consists for example of a graded gravel bed, i.e., wherein a coarse gravel or other aggregate is deposited near the drain pipe or similar conduit at the bottom of the wall, while the uppermost layer consists of a very fine gravel or sand to prevent clogging of the bed. These known filter layers are thus constructed to provide a gradual or stagewise variation of porosity in a vertical direction.

Although a gravel bed having a width or thickness (measured horizontally) of about 20 cm. may be sufficient to achieve the desired drainage, a thickness of at least about 60 cm. is generally chosen since safety regulations and construction specifications require that the original excavation be accomplished such that after the foundation wall is raised, the workman applying the sealer coat or layer can work without danger. In other words, a trench of at least about 60 cm. in width remains between the sealer coat on the wall and the inner earthen wall of the excavation. To first partly fill this trench with earth in order to reduce the drainage trench to a width of 20 cm. would not only be too costly but also too dangerous on account of the possibility of damaging the sealer coat. For this reason, one simply introduces gravel into the entire trench. Even then, extreme care must be exercised to avoid damage to the sealer coat or layer.

A gravel bed for drainage is thus rather uneconomical due to the unnecessarily wide bed construction and only conceals the potential danger of damage to the sealing layer.

In another known vertical drainage system, a porous checker-brick is used as the filter layer. The brick available at the construction site is stocked or piled to produce the drainage. This avoids some of the disadvantages of a gravel bed drainage system, but on the other hand it is much more expensive in terms of the hand labor required. Moreover, a variation in porosity over the height of the filter cannot be easily provided.

One object of the present invention is to provide a vertical drainage system for foundation walls in which a filter layer can be installed quickly and without damage to the sealer coat on the outer wall surface. Another object of the invention is to provide a filter layer or member which occupies only a slight space so that the necessary earth excavation can be kept smaller from the outset. Yet another important object of the invention is to provide a vertical drainage system which is substantially self-cleaning. In particular, it is especially intended that the drainage system of the invention prevent the entrainment of earth particles into the filter layer with a sudden or heavy flow of water around

and toward the foundation, i.e., so as to prevent stoppage of the filter or any excessive damming or retention of water against the foundation. These and other objects and advantages of the invention will become more apparent upon consideration of the following detailed specification.

It has now been found, in accordance with the invention, that a vertical drainage system or combination with a conventional foundation wall having an outer sealer coat if one provides between this sealer coat and the earth adjacent to the foundation a coarsely porous fleece web as the filter layer laid along the wall, preferably in surface contact with its one side against the outer sealed surface of the wall and with its other side against the earth, ground or other fill subject to the effects of rain or other surface water flowing there-through. This fleece web employed as the filter layer of the invention is composed of filaments of a fiber-forming synthetic thermoplastic polymer, preferably melt-spun continuous amorphous filaments which are looped and spun-bonded at random overlapping points to provide a coherent, firm and porous structure.

The term "fleece web" is employed herein to include not only the preferred continuous filaments but also a consolidated fibrous fleece material composed of cut staple fibers of a synthetic polymer, e.g., any waterlaid or airlaid filamentary structure which is preferably bonded where the filaments or fibers contact each other to provide a reasonably firm and very open or porous structure. In this connection, the term "coarsely porous" is employed herein to define a filter layer having a porosity of at least 40 percent and preferably 50 percent or more, i.e., so that the voids or empty space of the total filter volume corresponds to these percentages.

The fleece web filter layer of the invention is easily installed since it can be cut into lengths in the form of a number of strips and these can be adhered one after the other onto the sealing coat or layer on the outer surface of the foundation wall. Any conventional adhesive for the filamentary material of the fleece web can be used, or it is even possible to employ the sealing coat itself as the adhesive agent, i.e., where a liquid, highly adhesive, waterproofing coating material is first applied to the wall surface to form an initially tacky layer or film thereon and the fleece web of the invention is then immediately laid onto the tacky surface before it has an opportunity to dry. In this instance, one should select a conventional waterproofing agent which is adherent for both the masonry material of the wall and the thermoplastic polymer substance of the fleece web.

The invention is illustrated by way of example in the accompanying drawing wherein:

FIG. 1 is a partly schematic cross-sectional view taken through a portion of the construction site to show one preferred embodiment of the foundation wall vertical drainage system of the invention; and

FIG. 2 is a schematic side elevational view of a length of a preferred fleece web used as the filter layer of the invention (shown in a horizontal position in this instance).

As shown in FIG. 1, the foundation or masonry wall 1 is constructed in any conventional manner and the sealing coat or layer 2 applied to the outwardly facing wall thereof at least below grade or below the final ground level and preferably at least a short distance above or up to the top of the foundation if desired.

Onto this sealing coat 2 there is adhered the consolidated and coherent fleece web 3, such that the entire foundation wall 1 located below grade is covered by this web as the filter layer of the drainage system. The loose earth 4 originally removed for construction purposes is then filled back in up to the desired ground level, the drainage pipe 5 first being laid near the bottom of the foundation and in close proximity to the filter layer or web 3.

The footing 6 of the foundation is preferably adapted to extend horizontally outwardly of the vertical wall 1 to accommodate both the filter layer 3 and the drainage pipe 5 laid parallel to the wall 1. This not only permits the proper positioning of the drainage pipe and its associated filter layer but also tends to seal off the bottom of the foundation with the flow of water in the drainage system being directed preferentially from the filter layer 3 into the pipe 5. Such drainage pipes 5 are usually laid completely around the entire foundation enclosing a basement, cellar or the like, together with other conventional conduit means to draw or conduct the water away from the building structure, for example into storm sewers or the like. The connection and arrangement of such drainage pipe means is well known and does not constitute part of this invention except as to the initial placement of at least one such drain pipe 5 near the bottom of the foundation wall 1. In other respects, the final outflow of water can be accomplished according to any conventional means and the vertical drainage system of the invention is readily adapted to a wide variety of drainage pipe means.

The initial excavation line 7 is indicated schematically in FIG. 1, e.g., where it follows the basement floor with a downwardly projecting portion for the footing 6 and then outwardly to the surrounding earth 8 so as to remove that portion of earth designated by the numeral 4 to a width designated as B. This width is sufficient to permit a workman to easily apply the waterproofing or sealing coat and also required additional adhesive onto the outer wall surface of the foundation 1. In most instances the footing 6 together with a short segment of the wall 1 is first poured and set in place, and the remainder of the wall 1 is then raised and formed on the lagging 9 which is usually a wood or metal insert designed to provide a load supporting and/or insulating function between the upper wall and its footing.

In FIG. 1, the geometric proportions are shown approximately in scale size; with a trench width B between the sealing coat 2 and the unexcavated earth 8 of about 60 cm., the width or thickness of the fleece web 3 as the filter layer amounts to only about 10 percent of the trench width, i.e., about 6 cm. The remaining 90 percent or 54 cm. is thus refilled with the loose earth or any other suitable filling 4. For example, some gravel, sand or other aggregate can be mixed in with the loose earth so that the refilled zone 4 is somewhat more porous than in its original unexcavated form. However, this is not essential and would normally be adopted only where waste aggregate is readily available at the building site.

As shown in FIG. 1 and further illustrated in an enlarged view in FIG. 2, the preferred fleece web 3 used for purposes of the present invention has one side 3' facing the earth 4 of lower porosity and the other side 3'' facing the sealing coat 2 of higher porosity. The less open or more dense side 3' as indicated by more compact loops of filament is thus turned toward the earth

4 while the more open and less dense side 3'' as indicated by the larger loops of filament is fastened to the sealing layer 2 (compare FIG. 1).

An especially good openness or self-cleaning effect of the filter layer 3 is achieved when this difference of porosity on either side of the layer is maintained throughout the vertical drainage system, i.e., to provide a substantially uniform horizontal variation in porosity over the vertical height of the filter layer. Of course, one can also provide some variation of porosity in the vertical direction by using a number of horizontal bands or lengths of the fleece web of different density or porosity. However, very good results have been achieved simply by varying the porosity only as between the wall side and the earth side of the intermediate filter layer. As water flows from the ground or earth 4 into the filter layer 3, suspended or entrained solid particles of larger size tend to be filtered off and maintained outside of the filter layer while smaller particles of solids tend to be washed entirely through the system by the percolating water as it flows downwardly into the drainage pipe means. The requisite horizontally varied or staged porosity is thus a special advantage of the vertical drainage system of the invention.

The difference in porosity of the fleece web can be realized in a number of ways, for example by laminating or laying together two or more fleece webs of different porosities and arranging them on the sealing coat or outer waterproofed wall surface of the foundation such that there is a stagewise increase in porosity from the side facing the earth to the side facing the wall surface. However, other techniques can also be employed, especially by using the particularly preferred construction of the fleece web described more fully hereinbelow.

Especially good results have been achieved when the porosity of the filter layer or fleece web on the side facing the earth lies between about 50 percent and 70 percent while the porosity of the opposite side facing the sealing coat on the wall lies between about 85 percent and 95 percent. In such cases, a better-than-average filtration effect is achieved on the outer or earth side of the filter layer while water is still conducted very well on the inner or wall side of the filter layer.

According to the invention, an especially preferred embodiment of the fleece web is one in which continuous filaments are employed to form the fleece or porous but coherent web of a fiber-forming synthetic polymer.

In particular, it has been found to be most desirable to employ a fleece web insert or filter layer which is composed of a plurality of continuous, substantially amorphous, melt-spun synthetic thermoplastic polymer filaments which are arranged in approximately parallel rows in the form of sinuous to helical loops in overlapping relationship with each other, especially from looped filament to looped filament, with a self-bonding at random overlapping points of filament intersection. The individual loops of a single filament are generally formed approximately around a linear axis extending lengthwise of the finished web, with substantially parallel axes for all of the looped, overlapping and bonded filaments. The filament loops may thus appear somewhat as helically or spirally coiled springs in overlapping parallel rows and/or some or all of the loops may be flattened along the coil axis of each individual filament.

These particular fleece web structures can be formed according to the earlier disclosed processes in copending applications Ser. No. 807,301, filed Mar. 14, 1969 now U.S. Pat. No. 3,687,759, and Ser. No. 878,615, filed Nov. 21, 1969 now U.S. Pat. No. 3,691,004, the disclosures of which are incorporated herein by reference as fully as if set forth in their entirety.

In producing these preferred fleece webs, as schematically illustrated in FIGS. 1 and 2 where rows of sinuous to helical loops extend with their axes lengthwise and with a number of rows across the width or thickness of the web, it is thus preferred to spin the individual filaments from a spinning head as a polymer melt through spinning orifices arranged to provide the desired number of rows of looped filaments. The filaments are spun directly onto the surface of a water bath and are initially collected or supported on the surface of the bath in the form of a coil or loop which is then drawn downwardly for solidification below the bath surface. Adjacent coils or loops tend to bond with each other at the bath surface or short distance therebelow before the filaments have had a chance to completely solidify.

The density or porosity of the resulting fleece web when using these special processes can be controlled by the size and placement of the individual spinning orifices in the spinning head or nozzle plate. A denser structure or lower porosity is ordinarily achieved by using smaller spinning openings which are also arranged in closer proximity to each other. Larger filaments, preferably from orifices which are also more widely spaced, form correspondingly larger loops and lead to a relatively high porosity and a stiffer or less resilient structure. The arrangement of smaller orifices along one portion and larger orifices along the other portion in the face of the nozzle plate of the spinning head can therefore be utilized to produce a corresponding variation in density or porosity over the width of the resulting self-bonded, amorphous and looped filaments.

It is also possible, however, to produce this type of fleece web with a lower porosity on the underneath side and a higher porosity on the top side by melt-spinning filaments of the same diameter onto the surface of the aqueous cooling bath to form the desired loops while also inserting a smooth metal or ceramic deflecting plate a short distance below the surface of the bath at an angle to said surface of about 20° to 80°. The position of this plate with reference to the nozzle plate or face of the spinning head is chosen such that one outer row of the band of emerging filaments meets approximately at the line of intersection between the deflecting plate and the bath surface, this outer row corresponding to the "bottom" row of filaments as the band of filaments then rests and travels over the surface of the deflecting plate. The freshly spun and still highly plastic filaments lie on the bath surface to form loops while practically free of other influences except the buoyancy exerted on the filaments by the bath. Since the outer or "bottom" row of filaments tends to meet both the bath and the deflecting plate at the same time, i.e., so as to almost simultaneously contact the bath surface and the plate. These filaments are deflected from their normal path and position so as to lie almost parallel to the web plane or outermost web surfaces, i.e., the bottom side of the web as it is laid flat on the plate. An even greater adhesion occurs on this flattened side of

the web due to the more densely positioned points of contact of the intersecting filaments. The filaments of the adjacent rows lying higher above the deflecting plate and contacting it after somewhat greater cooling are likewise deflected or deformed from their initial position more strongly toward the plane of the plate the closer each row of filaments is toward the intersecting line of the plate and bath. The row of filaments in the band furthest away from this plate/bath intersecting line are influenced the least and may substantially retain the initial loop position which is almost perpendicular to the base or bottom of the web on the deflecting plate.

It is especially preferable for purposes of the present invention to provide such looped and partially deformed rows of overlapping filaments in such a manner that while the bottom loops are almost parallel to the deflecting plate, the upper loops are arranged at an angle of not more than 60° with reference to the level plane of the overall web. Also, the density must decrease from the bottom to the top of the web, preferably in accordance with the preferred values of porosity according to this invention. The porosities between the upper and lower sides of this web, i.e., in the intermediate rows or layers of looped filaments, then lie somewhere between the preferred values of each opposing side and in a relatively gradual variation from top to bottom.

In this manner, one can achieve especially useful filter layers or fleece webs for use in this invention without laminating separate fleece layers or gluing or adhering two or more distinct fleece layers to each other to provide the desired difference in porosity transversely of the elongated fleece web, i.e., horizontally to the final vertical position of the filter layer in the drainage system.

It is sufficient to employ a fleece web with a thickness of approximately 5 to 10 cm. so that this size of web is especially preferred. On the other hand, with difficult soil conditions it is also possible to use a fleece web as the filter layer of larger thickness, e.g., up to about 13 cm. Since these fleece webs are not only highly porous and light in weight but also relatively thin sheets or bands, they are very easily applied onto the waterproofed and adhesively coated foundation wall. The labor required is minimal and there is practically no possibility of damage to the sealing coat during application of the filter layer or in refilling the trench with earth to complete the installation of the drainage system.

Since the fiber-forming polyamides (nylons) such as polycaprolactam and polyhexamethylene adipamide are quite resistant to rotting or decomposition under all kinds of soil conditions as well as having other valuable properties such as abrasion resistance and the like, they are especially preferred in providing the filamentary material of the fleece web used as a filter layer in accordance with the invention. It will be understood, however, that many other fiber-forming synthetic thermoplastic polymers are also useful for the filter layer of the invention, for example linear polyesters such as polyethylene terephthalate, polyolefins such as polypropylene or other addition polymers such as polyvinyl chloride or the like. All of these thermoplastic polymers can be readily melt-spun and then preferably formed into the fleece web as looped continuous filaments bonded at random points of intersection.

Individual filament diameters of about 0.1 to 1 mm. are especially preferred in the production of the webs by melt spinning onto the surface of an aqueous cooling bath as explained above. These relatively large filaments in the substantially amorphous form of the polymer, e.g., nylon, provide a very coherent and relatively rigid structure in the transverse direction so as to withstand compression between the foundation wall and the surrounding soil. At the same time, the desired variation in density or porosity in this transverse direction can also be predetermined and maintained after installation of the vertical drainage system.

The vertical drainage system according to the present invention is particularly designed to handle a large flow or percolation of water, e.g., during severe rain storms, thereby quickly relieving pressure on the foundation wall as well as providing means to gradually withdraw underground water adjacent a building foundation. The self cleaning action of the drainage system of the invention is of value not only in the proper functioning and long life of the filter layer but also in the avoidance of a dense moist material which encourages root growth from trees, shrubs or other vegetation. Although it is feasible to add other materials or elements in the vertical drainage system of the invention, the simplicity and relatively low cost of the fleece web as the essential filter layer is of particular advantage in avoiding complex structures and building construction methods.

The invention is hereby claimed as follows:

1. A vertical drainage system for a basement foundation wall having a water impervious sealer coat on its outer surface, said system comprising a porous filter layer laid along said wall between said sealer coat and the earth adjacent the foundation, said filter layer being a non-woven fleece web composed of filaments of a fiber-forming synthetic thermoplastic polymer, and a drainage pipe means arranged near the bottom footing of said foundation wall to lead off water percolated through said filter layer.

2. A vertical drainage system as claimed in claim 1 wherein that side of the fleece web facing the earth has a lower porosity than the opposite side facing the sealer coat.

3. A vertical drainage system as claimed in claim 1 wherein said fleece web consists of continuous filaments of said fiber-forming synthetic thermoplastic polymer.

4. A vertical drainage system as claimed in claim 1 wherein said fleece web consists of a plurality of substantially amorphous filaments of a melt-spun polymer lying in rows of loops intersecting one another, said filaments being adhered to each other at random points of intersection.

5. A vertical drainage system as claimed in claim 4 wherein said fleece web has a thickness of about 5 to 10 cm.

6. A vertical drainage system as claimed in claim 1 wherein that side of the fleece web facing the earth has a porosity between about 50 and 70 percent while the porosity of the opposite side of the fleece web facing the sealer coat is between about 85 and 95 percent.

7. A vertical drainage system as claimed in claim 1 wherein said fleece web is composed of a fiber-forming synthetic polyamide.

8. A vertical drainage system as claimed in claim 4 wherein said melt-spun polymer is a fiber-forming polyamide.

9. A vertical drainage system as claimed in claim 4 wherein the fleece web has a lower porosity on that side facing the earth than on the opposite side facing the sealer coat.

10. A vertical drainage system as claimed in claim 9 wherein said fleece web has a thickness of about 5 to 10 cm., a porosity on the side facing the earth of about 50 to 70 percent and a porosity on the opposite side facing the sealer coat of about 85 to 95 percent.

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