

PATENT SPECIFICATION

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(54) EARTH DRAIN

(71) We, BURCAN INTERNATIONAL LIMITED, a company organized and existing under the laws of the Republic of Ireland, whose full post office address is 51-53 Fitzwilliam Square, Dublin, Ireland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement.

The present invention relates to earth drains adapted to the drainage of soil having low water permeability such, for example, as clay.

Certain soils such as clay have low water permeability and do not drain well with the result that such soils are often inappropriate for the purpose for which the land is intended, be it the construction of residential or commercial buildings, the construction of road beds or highways, or for agricultural or similar purposes. Such soils can be rendered more suitable for the purpose for which they are intended by the provision of drains which permit the pore water to be drained away before any intended construction is carried out. A basic drain used for this purpose is a conventional sand drain which is formed by inserting pipes into the ground through the layer of soil having low water permeability and into a layer of soil having relatively high water permeability such as sand or silt which drains water more readily. The pipe is filled with sand and then withdrawn leaving a column of sand extending through the soil layer having low permeability into the soil layer having relatively high permeability. The resulting sand column permits ground water to pass readily through the clay layer into the layer of relatively high permeability where it may be dispersed by normal drainage; alternatively, the sand column may permit the ground water to escape upward to the ground surface. Such sand drain also permits drainage

of pore water in the soil having low permeability, which pore water is squeezed out of the ground by a load, for example, a fill surcharge on the ground surface. The pore water is squeezed into the same column, which offers less resistance to the flow of water than the soil of low permeability, and which then permits the pore water to drain into the soil exhibiting relatively high water permeability, or to escape to the ground surface.

A drain which forms a substitute for the aforementioned sand column, and which may also be suitable for irrigation or similar purposes, is illustrated in Wager Canadian Patent Specification No. 930,999, dated July 31st, 1973. This drain consists of a relatively flat core consisting of a wave-shaped strip of plastic which is encased in a filter of water permeable sheet-like material. The troughs in the wave-shaped strip form channels for the dispersion of water and the filter material permits the passage of water there-through into the troughs but prevents the ingress of soil or other particulate matter which would tend to block the channels formed by the troughs and thus deleteriously affect the performance of the drain. While this type of drain has many advantages over the basic sand drain, it also has certain disadvantages arising in part from the fact that there is no communication between the water carrying channels formed by the troughs in the wave-shaped strip of the core. Thus, if one of the channels becomes blocked at any point throughout its length, such as by tearing or breakage of the filter material to permit the ingress of sand or particulate material, or by the soil pressure forcing the filter material into the troughs of the wave-shaped strip, the particular channel or channels so blocked become useless insofar as the drainage of water through the point of blockage is concerned. If many or all channels become blocked, the drain

becomes ineffective. Further, even if none of the water carrying channels is blocked or its flow areas reduced by the earth pressure forcing the filter material into the channel, the effective flow area of such drains is relatively small owing to the relatively low ratio of open area to solid area.

The disadvantages of earth drains in accordance with the aforementioned Canadian patent 930,999 can be substantially reduced if not eliminated by the use of drains in accordance with the present invention, which provides an earth drain comprising a core consisting of an elongate web having on at least one surface thereof a first array of projections of uniform height and a second array of projections of a height less than the projections of said first array, the projections of said second array being interspersed amongst projections of said first array, and a filter of sheet like water permeable material encasing said one surface and being supported in spaced relationship to said web by the free ends of the projections of said first array, and additionally by the free ends of the projections of the second array when the filter is deformed by the soil pressure acting on it in use of the drain. Preferably the web has corresponding arrays of projections on both surfaces, and apertures are provided in the web to permit water to pass freely from one side of the web to the other.

The use of spaced projections as opposed to elongated corrugations, permits both lateral and vertical flow of water through the drain in a random manner and the apertures through the web permit water to pass freely from one side of the web to the other if for any reason the flow area along one side of the web should be blocked or reduced. Further, the ratio of free area to solid area is high when contrasted with the known corrugated construction and a correspondingly higher flow of water is permitted through the drain. A further advantage is that the use of two arrays of projections prevents the soil pressure from forcing the filter material against the web to completely block any flow channel and, if, in the unlikely event this should happen, the provision for the lateral flow of water over the web permits water to bypass any such obstruction. A further advantage of the drain of the present invention is that the open flow area through the drain is increased several times in comparison with the drain of Canadian patent 930,999, thus proportionately, increases the efficiency of the drain of the present invention over that of the known drain, when comparing drains of the same overall size.

In drawings which illustrate an embodiment of the invention, two forms of drain in accordance with the invention will now be described by way of example, with reference

to the accompanying drawings in which:

Figure 1 is a plan view of a drain segment with the filter partly broken away to show the arrangement of studs or projections,

Figure 2 is a cross section of the drain of Figure 1 showing the relationship between the web and the filter under relatively low soil pressures;

Figure 3 is a cross section of the drain of Figure 1 showing the relationship between the filter material and the web under relatively high soil pressures;

Figure 4 is a cross section of a modified web construction.

Figure 5 is a cross section of a drain incorporating the modified web construction of Figure 4; and

Figure 6 is a cross section of the drain of Figure 5 separated to receive a tube.

The drain illustrated in Figures 1 to 3 comprises a core generally designated 1 encased in a sheath of filter material 2 which completely surrounds the core and permits the passage of water therethrough while preventing the ingress of particulate matter such as sand grains, silt or clay particles. The core consists of a relatively thin base or web 3 from both sides of which project a first array of projections or studs 4 of uniform height, and a second array of projections or studs 5 of uniform height, but of less height than the studs 4. In the embodiment illustrated, the studs 4 and 5 are arranged in rows extending longitudinally of the web and the rows are spaced apart laterally of the web.

The projections in each row are set apart at equal spacings and adjacent rows offset longitudinally of each other relative to each other by half that spacing so that each stud 5 is centrally disposed with respect to four adjacent studs 4. This particular regular arrangement is not essential, although it is preferable as to appearance, ease of manufacture and operability. Further, it is not essential that there be studs arranged on both surfaces of the web 3, although, again, the provision of studs on both surfaces is preferable in most cases in that it doubles the flow area available for drainage water when contrasted with an embodiment having studs on only one surface of the web 3.

Both the core 1 and the filter 2 may be formed of any of a variety of materials suitable for the purpose. Suitably the core may be formed of polyethylene, although other suitable plastics materials or even metals such as steel or aluminum could be used, and the filter may be formed of a suitable heavy duty filter paper such as is used commercially with earth drains such as those disclosed in the aforementioned Canadian Patent Specification No. 930,999. The dimensions of the drain are not critical, although a typical drain may have a web

thickness of about 1 millimeter, a width of about 100 millimeters, studs 4 and 5 of about 2 millimeters in diameter with studs 4 being about 2.5 millimeters in height and studs 5 being about 1.25 millimeters in height. Preferably, the distances A between the outer extremities of rows of studs 4 and 5 will be in the order of about twice the thickness of the filter material, for example between 0.5 and 2 millimeters to minimize the likelihood of the filter material being pressed into contact with the web under high soil pressures. The drain may be made of any convenient length, for example, 500 feet or more. If such lengths of drain are produced it is convenient that the material of which the drain is composed be relatively flexible so that it can be stored in coils or rolls. It will be appreciated that, in the drawings, distances and sizes have been exaggerated for the purposes of illustration and are not intended to be scale.

Figure 2 of the drawings illustrates, in cross section, the relationship between the filter 2 and the core before the drain is installed or where the installed drain is subjected to relatively low soil pressures. In such cases the filter will be supported by the free ends of the studs 4 so that the free spaces between the studs (as best seen in Figure 1) and the web and the filter will form a flow passage for drainage water.

Figure 3 illustrates, in cross section, an installed drain which is subjected to relatively high soil pressures. In this case, the flow passage for drainage water is constricted somewhat when contrasted with Figure 2 in that the soil pressure forces the filter material inwardly toward the core web. However, when this occurs, the auxiliary or lower studs 5 will provide additional support for those portions of the filter which are forced inwardly and, provided the distance "A" is not greater than twice the thickness of the filter material, it will be practically impossible for the filter material to be forced into contact with the web to completely constrict the drainage water flow passage. Indeed, even where distance "A" is greater than twice the thickness of the filter material, the arrangement of studs is such that without rupture of the filter, it would be practically impossible to completely block the flow passage for drainage water. However, in the unlikely event that this should occur, apertures 6 may be provided through the web to bring the flow passages on each side of the web into fluid communication. Thus, if for any reason the flow passage on one side should become blocked or unduly restricted, drainage water passing down the blocked or constricted side may pass freely to the other side and thus bypass the restriction.

The embodiment illustrated in Figures 1,

2 and 3 is a preferred embodiment shown for purposes of illustration only. It will be appreciated that various modifications will be possible, for example, in both the form and arrangement of studs. The studs illustrated in the embodiment of Figures 1, 2 and 3 are of circular cross-section, although other cross-sections such as square, rectangular or cruciform, would also be available for use and, in certain circumstances, may be considered preferable.

A modified embodiment of the drain of Figures 1, 2 and 3 is shown in Figures 4, 5 and 6 in which like components are identified by the same reference numerals as used in the previous figures. The difference between this modified embodiment and that of Figures 1, 2 and 3 lies principally in the construction of the core. According to this embodiment, the core is comprised of a single web which has studs 4 and 5 formed on only one surface thereof and which is cut partially through at 10, along its longitudinal centerline to leave a connected hinge portion 11. The web portions on each side of the centerline are identical so that the web may be folded about the hinge 11 to form a core which corresponds to that of Figures 1, 2 and 3 as illustrated in Figure 5.

The advantage of this modified embodiment, apart from ease of manufacture of the core, is that the two halves of the core may be spread apart slightly as shown in Figure 6 for insertion of a pipe or tube therebetween. Such tube may be used for injection of chemicals, such as lime through the drain, into the soil, for the purpose of improving the properties of the soil adjacent to the drain.

WHAT WE CLAIM IS:

1. An earth drain comprising a core consisting of an elongate web having on at least one surface thereof a first array of projections of uniform height and a second array of projections of a height less than the projections of said first array, the projections of said second array being interspersed amongst projections of said first array, and a filter of sheet-like water permeable material encasing said one surface and being supported in spaced relationship to said web by the free ends of the projections of said first array, and additionally by the free ends of the projections of the second array when the filter is deformed by the soil pressure acting on it in use of the drain.

2. An earth drain as claimed in claim 1, wherein said web is of uniform width and said first and second arrays of projections are disposed on both surfaces thereof.

3. An earth drain according to claim 1 or 2 wherein the projections of the first and second arrays are arranged in alternative parallel rows, the projections in each row being at a uniform spacing from each other



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3
12

thickness of about 1 millimeter, a width of about 100 millimeters, studs 4 and 5 of about 2 millimeters in diameter with studs 4 being about 2.5 millimeters in height and studs 5 being about 1.25 millimeters in height. Preferably, the distances A between the outer extremities of rows of studs 4 and 5 will be in the order of about twice the thickness of the filter material, for example between 0.5 and 2 millimeters to minimize the likelihood of the filter material being pressed into contact with the web under high soil pressures. The drain may be made of any convenient length, for example, 500 feet or more. If such lengths of drain are produced it is convenient that the material of which the drain is composed be relatively flexible so that it can be stored in coils or rolls. It will be appreciated that, in the drawings, distances and sizes have been exaggerated for the purposes of illustration and are not intended to be scale.

Figure 2 of the drawings illustrates, in cross section, the relationship between the filter 2 and the core before the drain is installed or where the installed drain is subjected to relatively low soil pressures. In such cases the filter will be supported by the free ends of the studs 4 so that the free spaces between the studs (as best seen in Figure 1) and the web and the filter will form a flow passage for drainage water.

Figure 3 illustrates, in cross section, an installed drain which is subjected to relatively high soil pressures. In this case, the flow passage for drainage water is constricted somewhat when contrasted with Figure 2 in that the soil pressure forces the filter material inwardly toward the core web. However, when this occurs, the auxiliary or lower studs 5 will provide additional support for those portions of the filter which are forced inwardly and, provided the distance "A" is not greater than twice the thickness of the filter material, it will be practically impossible for the filter material to be forced into contact with the web to completely constrict the drainage water flow passage. Indeed, even where distance "A" is greater than twice the thickness of the filter material, the arrangement of studs is such that without rupture of the filter, it would be practically impossible to completely block the flow passage for drainage water. However, in the unlikely event that this should occur, apertures 6 may be provided through the web to bring the flow passages on each side of the web into fluid communication. Thus, if for any reason the flow passage on one side should become blocked or unduly restricted, drainage water passing down the blocked or constricted side may pass freely to the other side and thus bypass the restriction.

The embodiment illustrated in Figures 1,

2 and 3 is a preferred embodiment shown for purposes of illustration only. It will be appreciated that various modifications will be possible, for example, in both the form and arrangement of studs. The studs illustrated in the embodiment of Figures 1, 2 and 3 are of circular cross-section, although other cross-sections such as square, rectangular or cruciform, would also be available for use and, in certain circumstances, may be considered preferable.

A modified embodiment of the drain of Figures 1, 2 and 3 is shown in Figures 4, 5 and 6 in which like components are identified by the same reference numerals as used in the previous figures. The difference between this modified embodiment and that of Figures 1, 2 and 3 lies principally in the construction of the core. According to this embodiment, the core is comprised of a single web which has studs 4 and 5 formed on only one surface thereof and which is cut partially through at 10, along its longitudinal centerline to leave a connected hinge portion 11. The web portions on each side of the centerline are identical so that the web may be folded about the hinge 11 to form a core which corresponds to that of Figures 1, 2 and 3 as illustrated in Figure 5.

The advantage of this modified embodiment, apart from ease of manufacture of the core, is that the two halves of the core may be spread apart slightly as shown in Figure 6 for insertion of a pipe or tube 12 therebetween. Such tube may be used for injection of chemicals, such as lime through the drain, into the soil, for the purpose of improving the properties of the soil adjacent to the drain.

WHAT WE CLAIM IS:

1. An earth drain comprising a core consisting of an elongate web having on at least one surface thereof a first array of projections of uniform height and a second array of projections of a height less than the projections of said first array, the projections of said second array being interspersed amongst projections of said first array, and a filter of sheet-like water permeable material encasing said one surface and being supported in spaced relationship to said web by the free ends of the projections of said first array, and additionally by the free ends of the projections of the second array when the filter is deformed by the soil pressure acting on it in use of the drain.

2. An earth drain as claimed in claim 1, wherein said web is of uniform width and said first and second arrays of projections are disposed on both surfaces thereof.

3. An earth drain according to claim 1 or 2 wherein the projections of the first and second arrays are arranged in alternative parallel rows, the projections in each row being at a uniform spacing from each other

and offset from the projections in the adjacent rows.

4. An earth drain as claimed in claim 1, 2 or 3 including a plurality of apertures through said web.

5. An earth drain comprising an elongate water impermeable flexible web of uniform width and having on each surface thereof, a first array of longitudinally extending laterally spaced rows of uniformly spaced projections of uniform height, and a second array of longitudinally extending, laterally spaced rows of uniformly spaced projections of uniform but of lesser height than the projections of said first array each row of said first array being separated from an adjacent row of the first array by a respective row of the second array, and a filter of sheet like water permeable material encasing each said surface and being supported in spaced relationship to said web by the free ends of the projections of said first array, and additionally by the free ends of the projections of the second array when the filter is deformed by the soil pressure acting on it in use of the drain.

6. An earth drain as claimed in claim 5,

wherein the projections in the respective rows are set apart at equal spacings, and adjacent rows are offset longitudinally relative to each other by half that spacing.

7. An earth drain as claimed in claim 5 or 6 wherein the spacing between adjacent rows of projections is not greater than twice the thickness of the material of which the filter is composed.

8. An earth drain as claimed in claim 5, 6 or 7 wherein said web is provided with a plurality of apertures therethrough.

9. An earth drain as claimed in any of the preceding claims, wherein said projections are of circular cross section.

10. An earth drain substantially as disclosed herein with reference to Figures 1, 2 and 3 of the drawings.

11. An earth drain substantially as disclosed herein with reference to Figures 4, 5 and 6 of the drawings.

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