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(54) Module for forming drainage trenches in the ground

(57) The module (10) comprises: a mass (11) of loose, relatively small and light solid objects, such as to define a body with drainage properties comparable to or better than gravel, a fibre layer (15) covering the mass of objects and possessing filtering properties such as to enable water to pass but to retain earth particles, and a metal mesh cage (21) able to retain the mass of loose objects together and to give the module a constant determined geometrical shape.

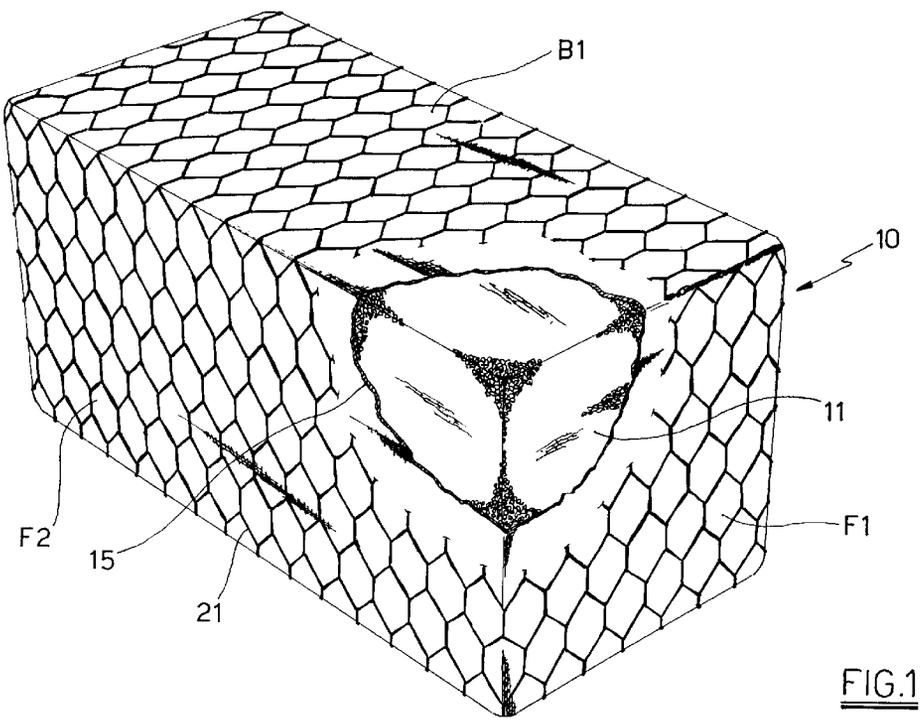

FIG.1

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Description

[0001] This invention relates to ground drainage works, and in particular to drainage trenches for removing surface meteoric water and deep infiltration water in unstable areas.

[0002] The traditional method for constructing said removal trenches is to form trenches which are filled with gravel or inert rubble, possibly after inserting a thin layer of impermeable material on the bottom of the trench. The meteoric or phreatic water is consequently collected from the trench and evacuated distant from the ground concerned. This method is used in particular for draining agricultural land or for removing deep water circulations in sliding ground.

[0003] A problem connected with the construction of said trenches is transferring the filling gravel into the trenches. In this respect, the gravel is very heavy and requires relatively heavy vehicles for its handling. This can often be a serious difficulty when working on intrinsically soft or marshy ground, or in the presence of rain, or if the ground is relatively steep.

[0004] An object of the invention is to provide means for constructing drainage trenches which are substantially at least as effective as traditional gravel trencnes, while able to overcome the described drawbacks.

[0005] This and further objects are attained by the invention as characterised in the claims.

[0006] The invention consists of a module substantially comprising:

- a body formed from a mass of loose, relatively small and light solid objects such as to provide the body with drainage properties comparable to or better than gravel,
- a fibre material layer covering the mass of objects and possessing filtering properties such as to enable water to pass but to retain earth particles,
- a metal mesh cage able to retain the mass of loose objects together and to give the module a constant determined geometrical shape.

[0007] The invention is described in detail hereinafter with the aid of the accompanying figures which illustrate two non-exclusive embodiments thereof.

[0008] Figure 1 is a perspective view of the module of the invention, wich some parts cut away.

[0009] Figure 2 is a section through the module of Figure 1 taken on a transverse vertical plane.

[0010] Figure 3 is a view from above of a plurality of modules aligned to form a drainage trench.

[0011] Figure 4 is a section through a second embodiment of the module of the invention taken on a transverse vertical plane.

[0012] Figure 5 is section through a plurality of modules of the type of Figure 4 aligned to form a drainage trench, the section being taken on a longitudinal vertical plane.

[0013] The module of the invention (indicated overall by 10 in the figures) comprises a mass 11 of loose, relatively small and light solid objects, such as to define a body with drainage properties.

[0014] On the outside of the mass 11 and covering it there is a fibre layer 15 possessing filtering properties such as to enable water to pass but to retain earth particles.

[0015] Finally, a metal mesh cage 21 covers the mass 11 together with the fibre layer 15. This cage 21 is able to retain the mass of loose objects together and to give the module a constant determined geometrical shape, in addition to giving the finished product considerable mechanical strength.

[0016] To construct the drainage trench using the module of the invention, a trench is firstly formed in the ground. Then a plurality of modules 10 are inserted into the trench and positioned in successive mutual contact by bringing a vertical face of one into contact with a vertical face of the next. For this purpose the module 10 is given an overall outer shape comprising at least one pair of opposing vertical flat faces F1 which are parallel and substantially identical to each other. In particular, the geometrical shape of the module is substantially a parallelepiped, which in addition to said faces F1 comprises two opposing vertical faces F2 and two horizontal faces B1.

[0017] The various modules 10 are positioned in successive mutual contact within the trench by bringing a face F1 of one into contact with a face F1 of the next. Alternatively, other faces of the modules can be brought into mutual contact.

[0018] The modules can also be positioned superposed in two or more planes within the object. In this case the modules are placed in mutual contact via horizontal faces.

[0019] Finally, the succession of modules is earthed up to embed them such that the top of the modules is either substantially at ground level or below ground.

[0020] The mass of objects 11 is chosen such as to give it drainage properties which are comparable to or better than gravel. In particular it has a permeability of 10^{-2}-10^{-3} m/sec.

[0021] The constituent solid objects of the mass 11 preferably have a dimension of between 10 and 30 mm and are constructed of synthetic resin. The objects are preferably sharp-edged.

[0022] In a preferred embodiment the solid objects are constructed of foamed polyurethane of density 5-20 kg per cubic metre. This material has proved to be very suitable for the function which it has to perform within the module of the invention, in that it has a relatively low specific gravity together with sufficient mechanical strength against compression caused by the thrust of the earth laterally surrounding the module, together with any earth lying on its top.

[0023] The fibre layer 15 can be of woven or non-woven fabric, in either case it being formed of unrottable

synthetic fibres.

[0024] The metal mesh cage is of highly galvanized iron construction, with a structure such as to retain the mass of objects 11 and to give it the required shape.

[0025] The layer 15 can be positioned external to the cage, in particular to prevent the cage 21, by virtue of any exposed rods or points which it may possess, from perforating any membranes (for example impermeable membranes) laid on the bottom of the trench.

[0026] It has been found experimentally that a drainage trench constructed with the modules 10 of the invention provides substantially the same performance, with regard to removal of meteoric water and infiltration water, as a traditional trench filled with gravel. The mass of objects 11 acts basically as the gravel, having a degree of permeability substantially equal to it. The cage 21 maintains the geometrical shape of the module 10 to the extent of resisting thrusts produced by the earth placed to the side and possibly on top of the module. It also serves to create a strong bonded barrier which contributes to binding and reinforcing the ground. The fibre layer 15 prevents the fine part of the earth penetrating into the mass 11, to block its passages and hence reduce its degree of permeability.

[0027] Moreover the modules are intrinsically very light and can hence be manipulated and transported by hand into the trench. This solves said drawbacks related with gravel transport and its pouring into the trench, particularly when working on intrinsically soft or marshy ground, or in the presence of rain, or if the ground is relatively steep.

[0028] In the embodiment shown in Figures 4 and 5, in addition to the aforedescribed the module 10 possesses a thin impermeable membrane 30 (for example a flexible plastic film) applied to the metal mesh cage 21, and having a lower portion 31 completely covering the lower face B1 and two side portions 32 folded against the vertical lateral faces F2 to at least cover the lower portion of these faces. The other two vertical lateral faces F1 are left completely uncovered. In practice the membrane 30 can be advantageously secured to the outside of the cage 21 (as shown in Figure 4), or can be positioned between the mass of objects 11 and the cage 21.

[0029] When the various modules 10 are positioned in successive mutual contact within the trench by bringing a face F1 of one into contact with a face F1 of the next, the various membranes 30 lie one behind the next, with their lower portions 31 coplanar and their lateral portions 32 also coplanar, the modules hence being arranged in such a manner as to define a water discharge channel which closes the trench lower face (formed by the succession of lower faces B1) and at least the lower portions of the lateral faces (formed by the succession of side faces B1) (see Figure 5). This channel is particularly useful for conveying the water which reaches the trench and to prevent it dispersing into the surrounding ground, especially if the permeability of the earth below the modules 10 is greater than or equal to that of the modules themselves.

[0030] Numerous modifications of a practical and applicational nature can be made to the invention, but without leaving the scope of the inventive idea as claimed below.

Claims

1. A module for forming drainage trenches in the ground, characterised by comprising:

   a mass of loose, relatively small and light solid objects, such as to define a body with drainage properties comparable to or better than gravel,
   a fibre layer covering the mass of objects and possessing filtering properties such as to enable water to pass but to retain earth particles,
   a metal mesh cage able to retain the mass of loose objects together and to give the module a constant determined geometrical shape.

2. A module as claimed in claim 1, characterised by having an overall outer shape comprising at least one pair of opposing vertical flat faces, which are parallel and substantially identical to each other.

3. A module as claimed in claim 1, characterised in that the constituent solid objects of said mass 11 have a maximum dimension of 10-30 mm and are constructed of synthetic resin.

4. A module as claimed in claim 3, characterised in that said solid objects are of foamed polyurethane having a density of 5-20 kg per cubic metre.

5. A module as claimed in claim 1, characterised in that said fibre material layer is formed of a non-woven fabric of unrottable synthetic fibre.

6. A module as claimed in claim 1, characterised by comprising a thin impermeable membrane applied to said metal mesh cage to completely cover its lower face (B1) and at least the lower portion of two lateral faces (F2) while leaving the other two lateral faces (F1) uncovered, in order to form a water-conveying discharge channel when the modules are mutually combined.

7. A method for constructing drainage trenches in the ground, using modules claimed in claim 1, characterised by comprising:

   - forming a trench in the ground,
   - then inserting a plurality of modules and placing them in successive mutual contact by bringing a face (F1) of one into contact with a face (F1)

of the next,

- finally earthing-up to embed the row of modules.

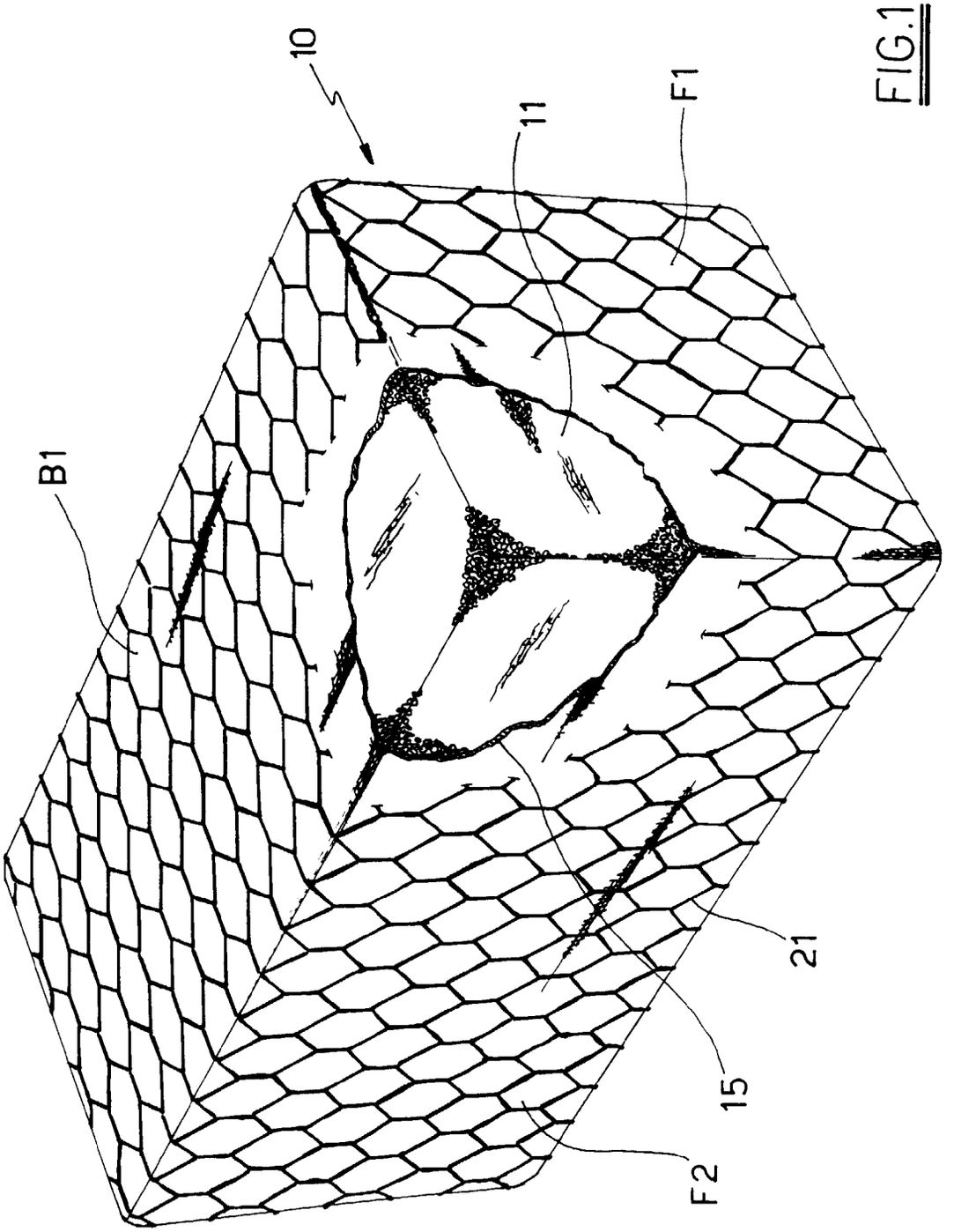

FIG.1

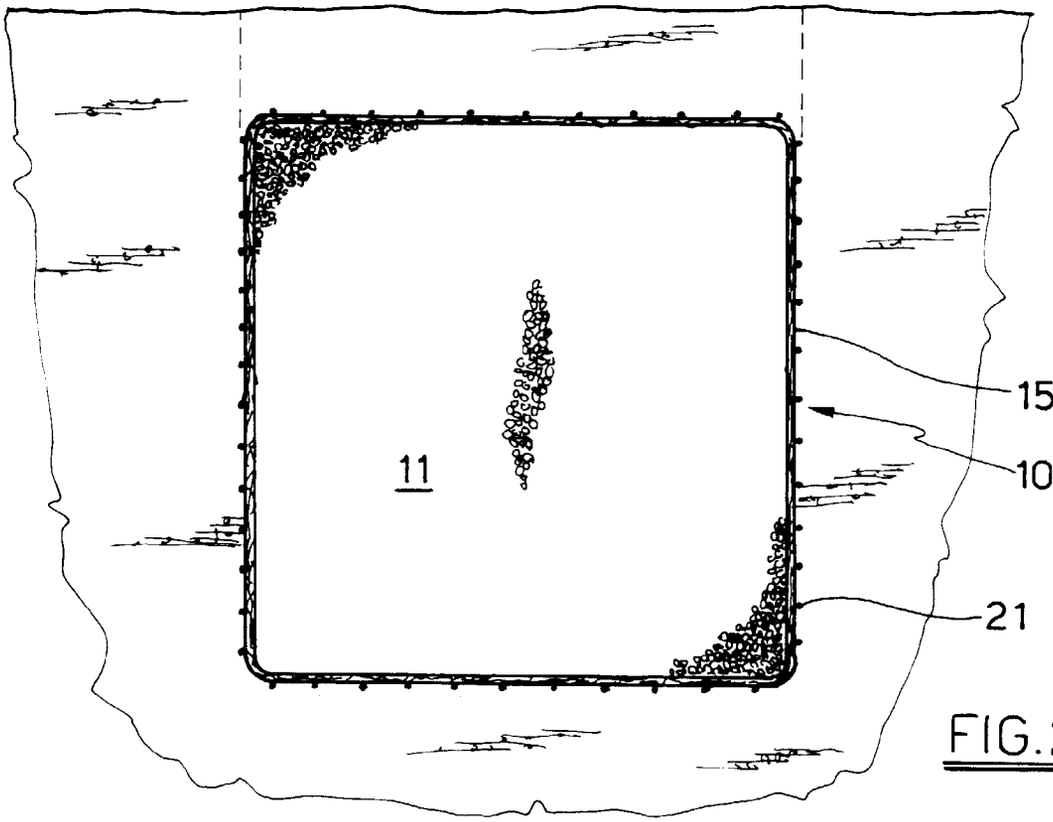

FIG.2

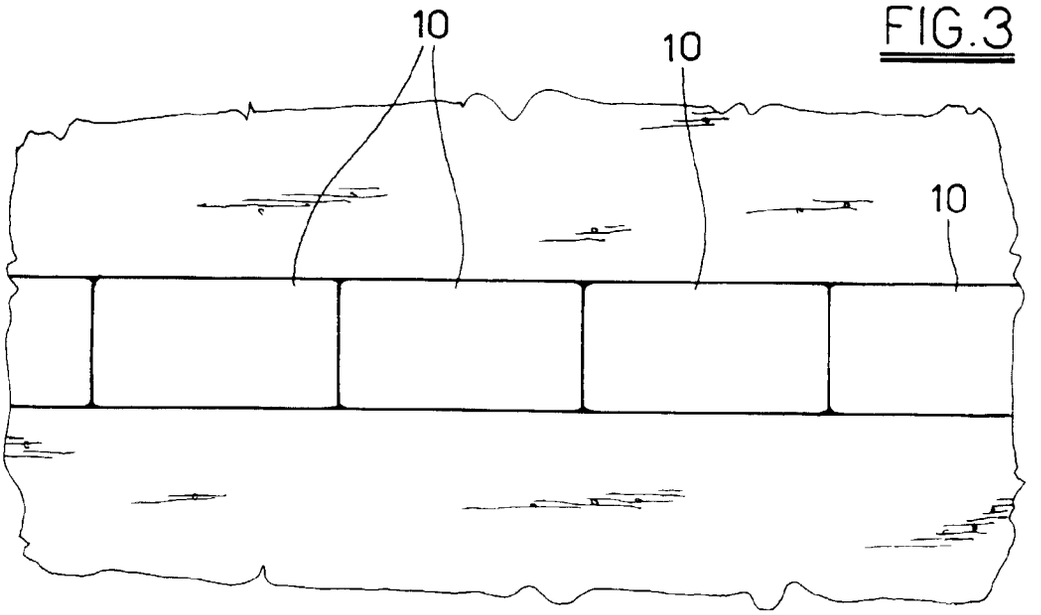

FIG.3

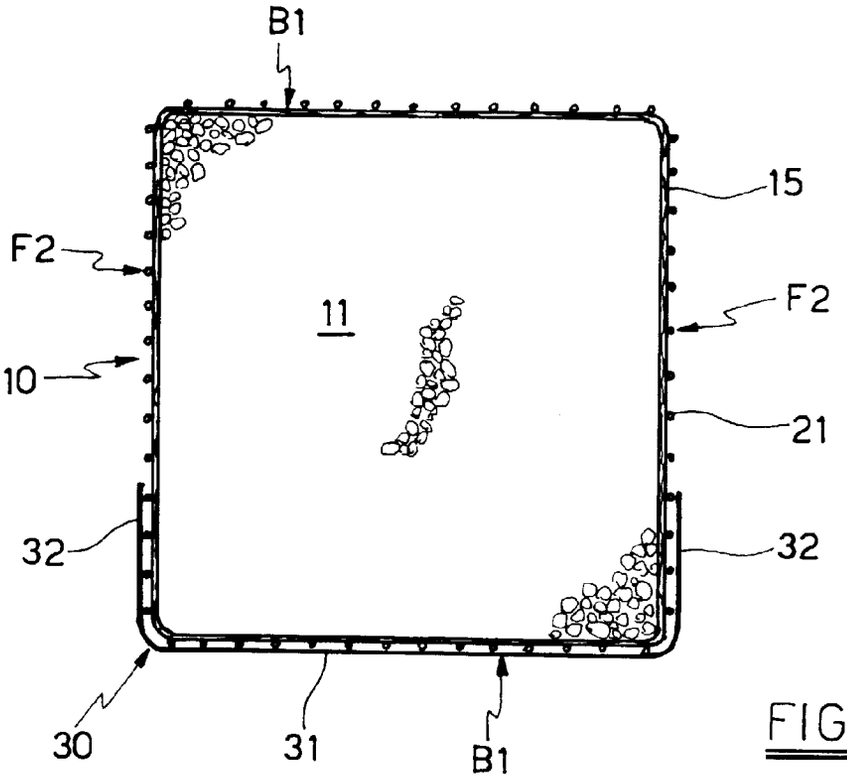

FIG.4

FIG.5