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54 Installation of highway drainage mat.

57 Installation in a narrow trench of an elongated drainage  
 mat which is not bendable in the plane of its base which is  
 maintained in a vertical orientation. The installation is  
 effected by deflecting the top edge of the mat into a wave  
 configuration to shorten the effective length of the top edge  
 to cause the mat to follow a curve lying in a vertical plane  
 within a narrow width.

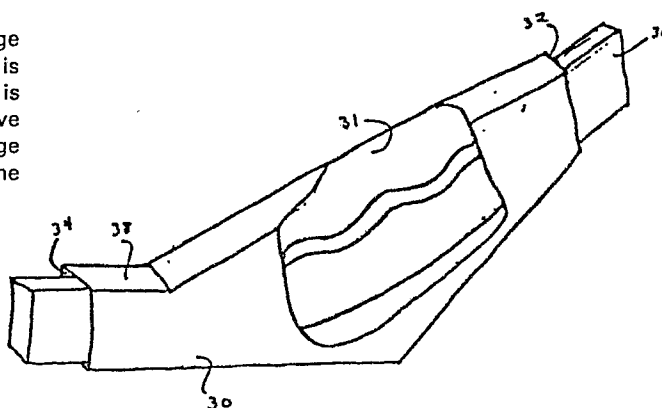


FIG. 3

INSTALLATION OF HIGHWAY DRAINAGE MATBACKGROUND OF THE INVENTION

This invention relates to methods and apparatus for inserting an elongated drainage mat in a trench. More particularly, this invention relates to the insertion of an elongated drainage mat in a vertical orientation in a trench particularly where such drainage mat is not bendable in a plane of such vertical orientation.

As disclosed, for instance in \_\_\_\_\_  
\_\_\_\_\_ EP-A-0124500, \_\_\_\_\_ a drainage mat particularly suitable as a highway edge drain has recently been developed. Such drainage mat can comprise a polymeric core having a plurality of substantially rigid fingers extending from one side of a support layer and an enveloping water permeable fabric. Such drainage mat has a rectangular transverse cross-section defined by opposing major surfaces in the plane of the support layer having the fingers extending therefrom and opposing minor surfaces corresponding generally to the length of the rigid fingers extending from the support layer. Such drainage mat is generally installed, as highway edge drain, in a vertical orientation in a trench, that is the support layer is in a vertical orientation. Such drainage mat is characterized as not bendable around an axis perpendicular to the plane of such major surfaces, that is the mat does bend in the plane of its support layer. The drainage mat is however bendable around axes in the plane of its support layer; that is the mat does bend out of the plane of its support layer. In particular, the mat can be bent so that its major surface proximate the support layer will be slightly concave; this is due to restraint to

bending by the fabric contacting the ends of the fingers at the major surface opposite the support layer. The mat can also be bent so that its major surface proximate the ends of the fingers can be extremely concave.

Because of such bending characteristics the installation of such drainage mat in a vertical orientation in a trench (i.e. with the major surfaces in a vertical plane) has been advantageously accomplished by pointing and orienting such drainage mat by the use of turning guides at an angle of  $45^{\circ}$  to the pointing direction of the elongated drainage mat. As disclosed, for instance in \_\_\_\_\_

\_\_\_\_\_ EP-A-024499, \_\_\_\_\_ such apparatus comprises a boot with parallel vertical walls. Such boot is pulled along the bottom of excavated trench and has within the walls a fixed guide positioned at an axis of about  $45^{\circ}$  from horizontal. An elongated drainage mat is passed vertically downward and around the fixed guide so that it exits from rear passage between the side walls of the boot in a vertical orientation at the bottom of an excavated trench. Trenches to accommodate such installation equipment must generally be at least eight inches (20 cm) wide, often at least about twelve inches (30 cm) wide, to accommodate the thickness of the side walls of the boot, the internal turning guide and clearances for two layers of drainage mat between the centrally located turning guide and the side walls of the boot.

In the installation of such drainage mat as a highway edge drain, an eight inch to twelve inch wide trench is excavated. The drainage mat is installed in the excavated trench by pulling the boot as described above through the trench with drainage mat passing through the boot and being deposited at the bottom of the trench in a vertical orientation. Earth excavated

from the trench is generally scraped by a blade to  
refill the trench between the drainage mat and the  
trench wall. The fill is generally compacted to the  
height of the drainage mat. The remaining open area  
5 of the trench, often of depth of between about three  
to six inches (7.5-15 cm), is then filled with an  
asphaltic concrete plug to restore the trench to the  
grade level of the road surface and shoulder. During  
this operation there are generally extended lengths of  
10 open trench along side of a highway. This can present  
some danger to vehicular traffic if a motor vehicle  
wheel should fall into the trench. Accordingly it  
would be desirable to provide for installation of such  
drainage mat in a narrower trench, e.g. about four  
15 inches (10 cm) wide or less to allow vehicle wheels to  
pass over the open trench without falling into the  
trench. Potentially dangerous situations could then  
be averted by the use of such narrow trench.

Drainage mat typically used as highway edge  
20 drain is generally on the order of about 3/4 to 2  
inches (2-5 cm) in thickness. The width required for  
such drainage mat to pass on both sides of a turning  
guide within the walls of a boot as described above  
makes it generally impractical to provide such ap-  
25 paratus as disclosed above that will operate in a  
sufficiently narrow trench.

By this invention applicants have provided  
apparatus and methods for installation of drainage mat  
in a narrow trench which overcomes the aforementioned  
30 deficiencies of the prior art.

Accordingly, a principle object of this  
invention is to provide apparatus and methods for  
installing an elongated drainage mat, which is not  
bendable in the plane of its major surfaces, in a  
35 narrow trench with its major surfaces in a vertical  
plane.

A further object of this invention is to provide apparatus and methods for such installation of elongated drainage mat without the use of turning guides about which the mat changes its direction  
5 with the walls of a boot.

This and other objects of the invention are accomplished by the apparatus and methods of this invention for installing drainage mat in a sufficiently narrow trench to provide the advantage of substantially  
10 reducing the possibility of potentially serious consequences from a vehicle wheel becoming lodged in wider trenches required by prior art methods and apparatus.

This invention provides a process for  
15 installing in a trench an elongated drainage mat of rectangular cross-section defined by opposing major surfaces and opposing minor surfaces. Such drainage mat is characterized as being not bendable in a plane of its major surfaces.

20 The process comprises positioning the drainage mat with its major surfaces in a vertical plane above the trench with the mat extending downwardly in an angle to the bottom of the trench. In this process the bottom edge of the mat is main-  
25 tained in a vertical plane while deflecting the top edge of the mat into a wave configuration to shorten the length of the top edge causing the mat to follow a curve lying in said vertical plane. As used herein the phrase "to shorten the length of the top edge"  
30 means for example to reduce the straight-line distance between two points on the top edge as compared to corresponding points on the bottom edge by effecting a wave configuration on the top edge while maintaining the bottom edge in a plane. Lengths of such drainage  
35 mat are installed in a trench by causing the mat to pass through such a curve and be deposited in the

trench with the major surfaces of the mat in a vertical plane.

5 This process can be effected by apparatus comprising an open box or chute having an inlet located above the trench and an outlet located at the bottom of the trench such that the drainage mat will pass through the inlets and outlets in a vertical orientation. The mat at the inlet is supported on its bottom edge; and at the outlet, on its top edge.

10 The side walls of the chute serve to separate the deflecting top edge of the drainage mat from the side walls of the trench and to assist in maintaining a trench wall in poor or collapsing soil conditions.

#### BRIEF DESCRIPTION OF THE DRAWINGS

15 Figure 1 illustrates an embodiment drainage mat installable by the method and apparatus of this invention.

Figure 2 is a cross-sectional illustration of drainage mat installed in a vertical orientation in a trench at the shoulder of a highway.

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Figure 3 illustrates one embodiment of apparatus useful in installing drainage mat according to the process of this invention.

#### DESCRIPTION OF A PREFERRED EMBODIMENT

25 The process of this invention readily allows installation in a vertical orientation in a trench an elongated drainage mat having a rectangular transverse cross-section. Figure 1 generally illustrate an embodiment of such drainage mat installable by the method of this invention. A water permeable fabric 1 envelops a core 2 having a plurality of substantially rigid fingers 4 extending from one side of a planar base 3. Such drainage mat is not bendable in the plane of base 3. In other words the mat is not

30

35 bendable around axis 6 which is perpendicular to the

planar base. Axis 5 indicates the alignment of the mat which would follow the length of a trench.

Figure 2 illustrates a transverse cross-section of drainage mat in a vertical orientation in a trench 4 where the mat is used as highway edge drain. Trench 10 is cut into the shoulder 12 at the edge of highway pavement 14 into the highway base material 16. Opposing major surfaces 20 and 22 are aligned in a vertical orientation and opposing minor surfaces 24 and 26 define a top edge at surface 24 and a bottom edge at surface 26.

With reference to Figure 3 there is shown one embodiment of apparatus useful in carrying out the process of this invention for installing drainage mat in a trench as illustrated in Figure 2. Such apparatus comprises opposing parallel walls 30 and 31 which are separated by distance sufficient to allow the apparatus to readily slide (e.g. by pulling) in an excavated trench. The apparatus has an open inlet 32 for receiving drainage mat 36 and an open outlet 34 for delivering the drainage mat in a vertical orientation in the trench. Opposing walls 30 and 31 are separated sufficiently to allow the top edge of the drainage mat to deflect into a wave configuration as illustrated in the cutaway section of the apparatus.

To install such drainage in a trench according to the process of this invention, a first part of the mat is positioned with its base layer in a vertical plane above the trench, for instance at the inlet 32. The bottom edge of this first part of the mat is supported by a bearing surface (not shown) which defines the lower edge of inlet 32. The mat extends downwardly between walls 31 and 32 at an angle to the bottom of the trench. A second part of the mat is positioned with its base layer in a vertical plane at the bottom of the trench, for instance at the outlet

34. The upper edge of this second part of the mat is supported by a bearing surface, for instance panel 38 between walls 30 and 31. The bottom edge of the section of the mat between these first and second parts is maintained in a vertical plane. The top edge of this section is deflected into a wave configuration to shorten the length of the top edge, causing the mat to follow a curve lying in the vertical plane. By passing the mat through the curve, the mat is deposited in the bottom of the trench. The mat is passed through the curve by advancing such bearing surfaces at the inlet and outlet, for instance by pulling the apparatus in a trench, allowing the drainage mat to be deposited therein.

The separation required between walls 30 and 31 depends on the curve to be followed by the mat between bearing surfaces and the thickness of mat. For instance, a drainage mat as illustrated in Figures 1 and 2 having a thickness (minor surface dimension) of about 1-1/8 inches (2.8 cm) and a height (major surface dimension) of about 11-3/8 inches (29 cm) was readily passed in a curve in a vertical plane between two walls of 1/4 inch (0.64 cm) thick steel plate. The walls were 2-1/2 inches (6.4 cm) apart. The bottom edge bearing surface was separated from the top edge bearing surface by a horizontal distance of 64 inches (162 cm) and a vertical distance of 15-1/2 inches (39 cm). Such drainage mat can be readily installed in a trench slightly wider than 3 inches (7.6 cm). With a greater horizontal distance between bearing surfaces, the separation between walls can be reduced permitting installation in even narrower trenches.

In other embodiments of apparatus useful in the process of this invention the walls can be curved at elevations above the trench to facilitate feeding the drainage mat to the vertical section of



the apparatus where the mat follows a curved path to the bottom of the trench.

5 In some embodiments of this invention the apparatus generally described herein can be advantageously integrated with trenching means, e.g. be provided with a plow blade which is pulled to excavate a narrow trench.

10 While the invention has been described herein with regard to certain specific embodiments, it is not so limited. It is to be understood that variations and modifications thereof may be made by those skilled in the art without departing from the spirit and scope of the invention.

What is Claimed is:

1. A process for installing in a trench an elongated drainage mat of rectangular cross-section defined by opposing major surfaces and opposing minor surfaces, said drainage mat being not bendable around an axis perpendicular to the plane of the said major surfaces, said process comprising:

(a) positioning the mat with its major surfaces in a vertical plane above the trench, said mat extending downwardly at an angle to the bottom of the trench, and

(b) maintaining the bottom edge of the mat in a vertical plane while deflecting the top edge of the mat into a wave configuration to shorten the length of said top edge to cause the mat to follow a curve lying in said vertical plane.

2. The process of claim 1 further comprising causing said mat to pass through said curve and be deposited in said trench with said major surfaces of said mat in a vertical plane.

3. A process for installing in a trench an elongated bendable drainage mat comprising a core of plurality of elongated fingers extending from a planar base layer and a water permeable fabric enveloping said core, wherein said mat is not bendable in the plane of said base, said process comprising:

(a) positioning a first part of the mat with its base layer in a vertical plane above the trench, said mat extending downwardly at an angle to the bottom of the trench, and

(b) a second part of the mat with its base layer in a vertical plane at the bottom of the trench, while maintaining the bottom edge of the section of the mat between said

first and second parts in a vertical plane while deflecting the top edge of said section into a wave configuration to shorten the length of said top edge to cause the mat to follow a curve lying in said vertical plane.

4. The process of claim 3 further comprising causing said mat to pass through said curve and be deposited in said trench.

5. The process of claim 4 wherein said mat is caused to pass through said curve by simultaneously advancing a first bearing surface at the bottom edge of said first part of the mat and a second bearing surface at the top edge of said second part of the mat.

6. The process of claim 5 wherein said bearing surfaces are located between parallel walls separately sufficiently to accommodate said wave configuration of the top edge of said section of the mat.

FIG. 1.

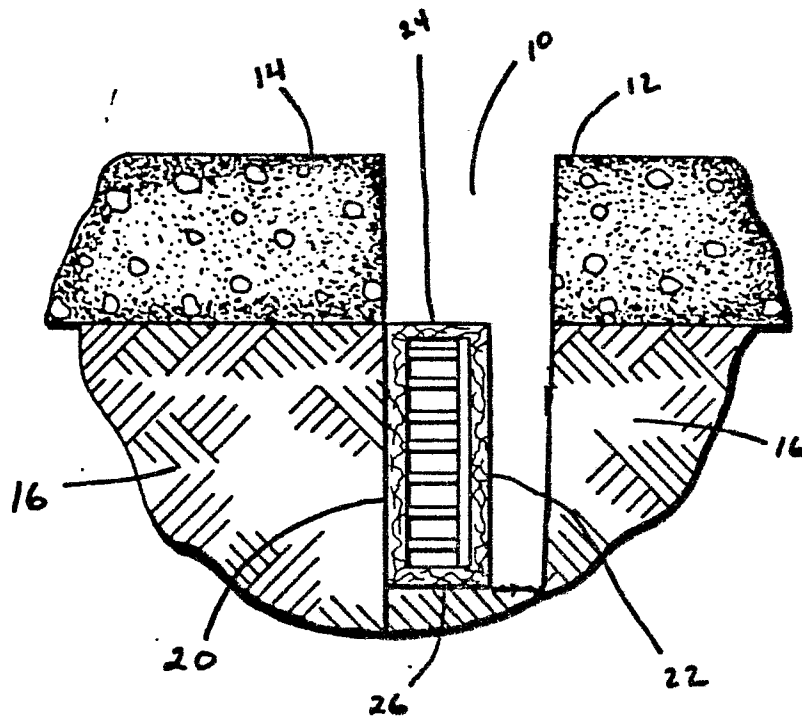
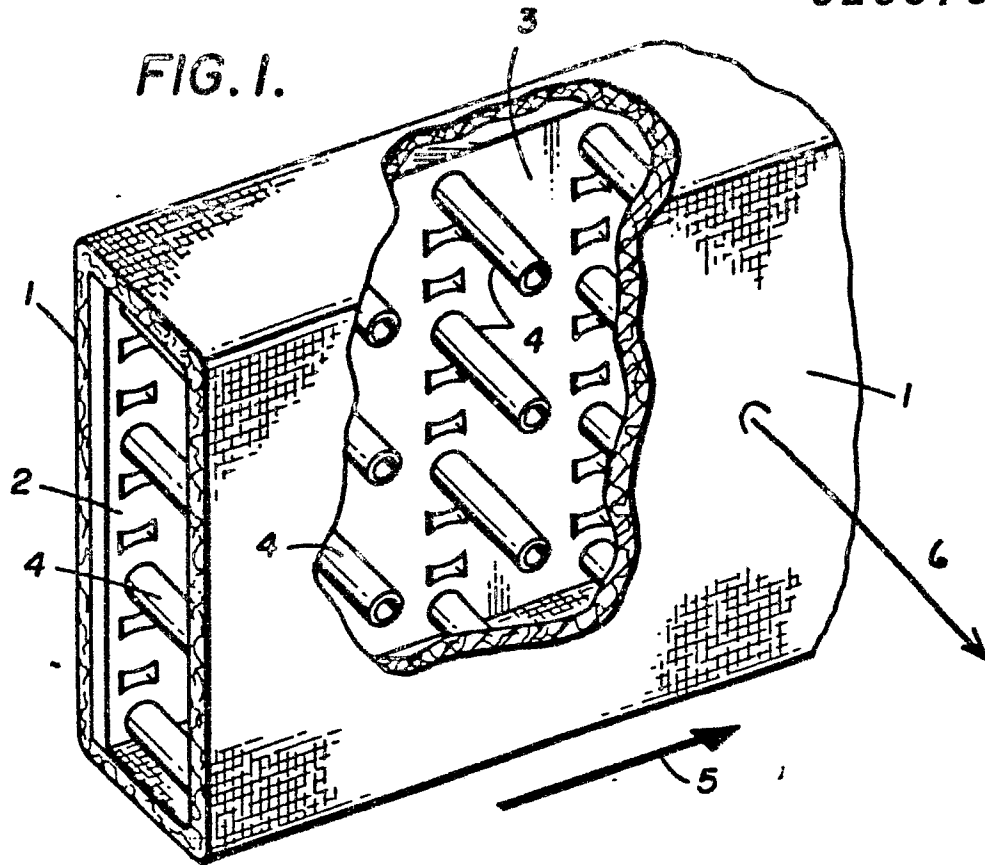


FIG. 2

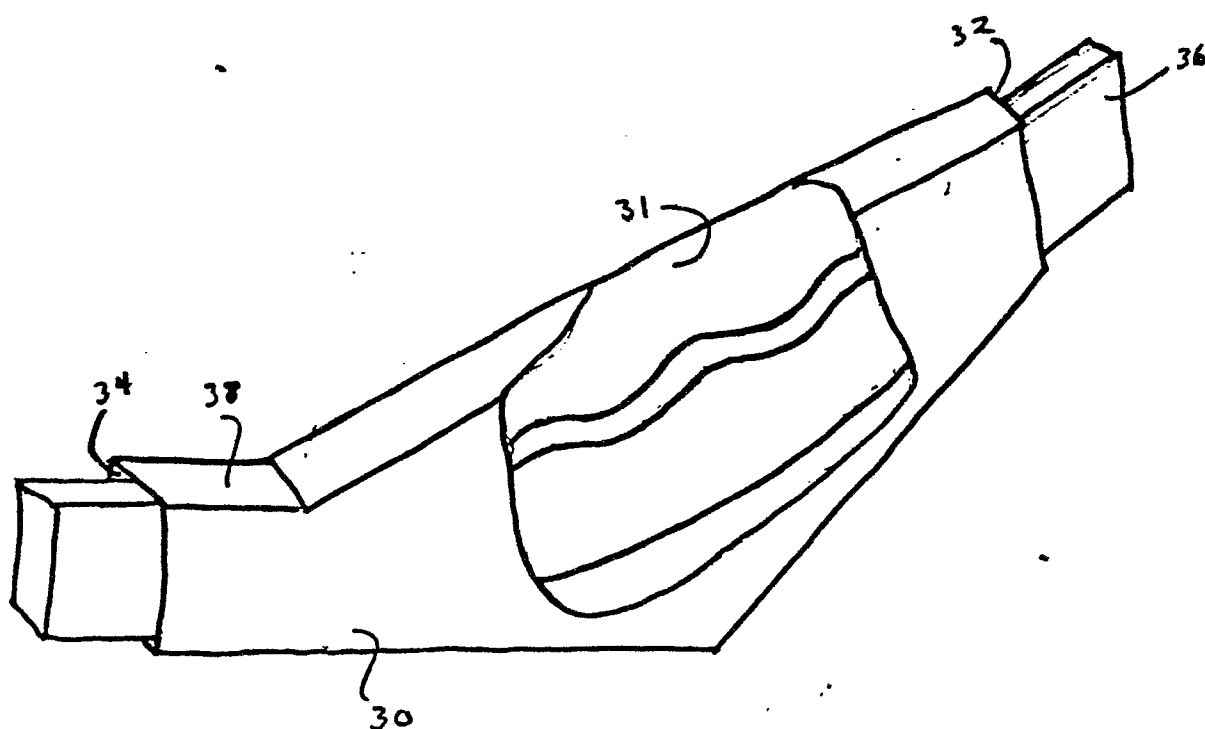


FIG. 3