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(54) **Drainage system**

(57) A drainage system 10 comprises a hollow catchment chamber 14 having an elongate mouth 16 through which liquid enters the chamber 14, and a body 18 having first and second angled surfaces 20a and 20b that direct the flow of liquid collected in the chamber 14 to an outlet 22. Preferably the body is a triangular shaped body 18. The angled surfaces 20 direct the flow of water and other liquids in a linear course directly to the outlet 22, from where it is forced down a dropper pipe 24. This provides the catchment chamber 14 with an aggressive, self-cleaning capacity. The dropper pipe 24 is connected to the outlet 22 of the catchment chamber 14 for dropping the liquid collected in the chamber 14 directly into a carrier pipe 12.

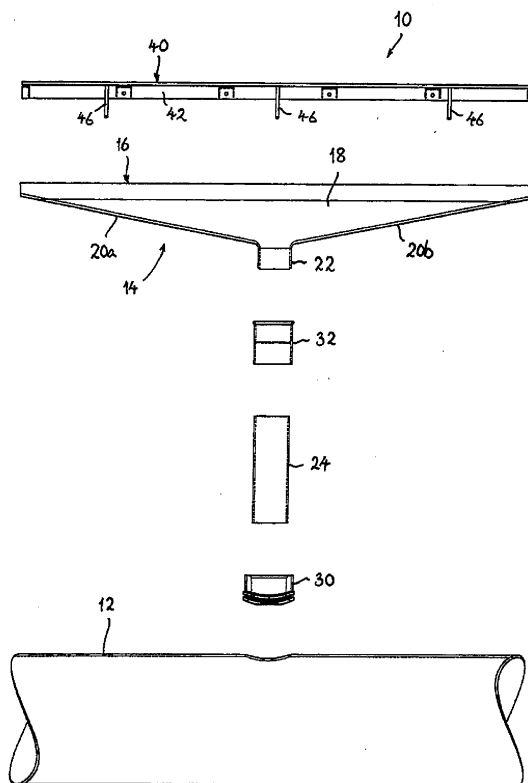


Figure 1

Description

[0001] The present invention relates to drainage system for draining water runoff from a roadway or other paved or sealed surfaces and relates particularly, though not exclusively, to a slot drainage system.

[0002] Many paved surfaces with large surface area, such as that of roadways, car parks, bus ports, petrol stations, truck stops, athletic playing surfaces, public squares or walkways, and airport runways require efficient water drainage so that slippery conditions caused by water lying on the surface can be minimised. Typically the drains need to be trafficable, i.e. pedestrians and vehicles need to be able to walk or drive over the drains without causing damage to the drain or to the vehicle or person. Therefore the drains are typically covered with some form of grate. Prior art drains are typically in the form of a U-shaped trench or channel made of concrete or plastics material which is embedded below the surface and covered with a grate. The channels come in a variety of depths to accommodate continual fall.

[0003] Prior art drainage systems typically require cranes and other mechanical equipment for installation as they are bulky and heavy weight. Also, in prior art "spoon" drains with flat bottoms of large surface area, low water flow leads to depositing of slit and sediment on the bottom of the drain. In the summer months this deposit dries and hardens. Sunlight entering the drain can result in germination of plants in the soil deposit, which further anchors the sediment in place.

[0004] The present invention was developed with a view to providing a drainage system which is less susceptible to the problems of the prior art.

[0005] References to prior art documents in this specification are provided for illustrative purposes only and are not to be taken as an admission that such prior art is part of the common general knowledge in Australia or elsewhere.

[0006] According to one aspect of the present invention there is provided a drainage system for draining stormwater or like liquids from a surface, the drainage system comprising:

a catchment chamber for collecting liquid comprising an elongate mouth through which the liquid enters the chamber and a hollow body having first and second angled surfaces that direct the flow of liquid in the chamber to an outlet;

a carrier pipe for carrying the collected liquid away; and,

a dropper pipe connected to the outlet of the catchment chamber for directing the liquid collected in the catchment chamber to the carrier pipe.

[0007] Typically the surface is paved.

[0008] Advantageously the catchment chamber is manufactured from a plastics material. Typically the mouth of the catchment chamber is in the form of a slot. Preferably the hollow body is a triangular shaped body. Preferably the triangular shaped body of the catchment chamber has first and second sidewalls which are oriented in a substantially vertical direction in situ and are joined together by the first and second angled surfaces to form the hollow body. Preferably the sidewalls have a necked portion adjacent the mouth of the chamber whereby the width of the slot is less than the width of the body of the chamber. Typically the catchment chamber is one of a plurality of catchment chambers, located in situ with the mouths of the chambers provided adjacent to each other end to end so as to form a substantially continuous drainage inlet.

[0009] Preferably when the catchment chamber is located in situ, concrete is poured around the chamber and underneath the hollow body to form a monolithic concrete slab which provides strength and support.

[0010] Preferably the system further comprises a rail which is mounted above the mouth of the catchment chamber so as to form an inlet for the catchment chamber. Preferably the rail comprises a pair of elongate members which are adapted to align with the longitudinal edges of the mouth of the catchment chamber. Preferably each elongate member has a plurality of wings extending from an outer surface of the member for anchoring the rail in the concrete after it has been poured. Preferably the rail is manufactured from metal. In one embodiment the rail is in the form of a grate made of ductile cast iron. In alternative embodiments the rail is made from galvanised steel or stainless steel.

[0011] In the grate one or more additional elongate members preferably extend parallel with the pair of elongate members, and are supported centrally between the elongate members on a series of transverse support crosspieces extending between the pair of elongate members.

[0012] Preferably the system further comprises a grommet, slip socket or welded socket for connecting the dropper pipe to the carrier pipe.

[0013] According to another aspect of the present invention there is provided a catchment chamber for a drainage system for draining stormwater or like liquids from a surface, the catchment chamber comprising:

an elongate mouth through which liquid enters the chamber and a hollow body having first and second angled surfaces that direct the flow of liquid in the chamber to an outlet.

[0014] Advantageously the catchment chamber is manufactured from a plastics material. Typically the surface is paved. Typically the mouth of the catchment chamber is in the form of a slot. Preferably the hollow body is a triangular shaped body. Preferably the triangular shaped body of the catchment chamber has first and second sidewalls which are oriented in a substantially vertical direction in situ. Preferably the sidewalls have a necked portion adjacent the mouth of the chamber whereby the width of the slot is less than the width of the body of the chamber.

[0015] Advantageously the catchment chamber is provided with a dropper pipe connected to the outlet of the catchment chamber for directing the liquid collected in the catchment chamber to a carrier pipe.

[0016] According to a still further aspect of the present invention there is provided a method of installing a drainage system for draining stormwater or like liquids from a paved surface, the method comprising the steps of:

digging a trench for the drainage system;

laying a carrier pipe in the bottom of the trench for carrying collected liquid away;

connecting a dropper pipe to the carrier pipe;

connecting a catchment chamber to the dropper pipe, the catchment chamber comprising a hollow body having first and second angled surfaces that direct the flow of liquid in the chamber to an outlet, the outlet of the catchment chamber being adapted to connect to the dropper pipe for directing the liquid collected in the catchment chamber; and,

connecting a rail to the catchment chamber so as to form an inlet for the catchment chamber;

pouring concrete around the catchment chamber and underneath the hollow body so as to form a monolithic concrete slab which provides strength and support.

[0017] Throughout the specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers. Likewise the word "preferably" or variations such as "preferred", will be understood to imply that a stated integer or group of integers is desirable but not essential to the working of the invention.

[0018] The nature of the invention will be better understood from the following detailed description of several specific embodiments of a drainage system, given by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is an exploded side elevation of a preferred embodiment of a drainage system according to the present invention;

Figure 2 is an exploded end elevation of the drainage system of Figure 1;

Figures 3 (a), (b) and (c) are a top plan view, a side elevation and an end elevation respectively of a catchment chamber of the drainage system of Figure 1;

Figure 4 is a cross-sectional view of a first embodiment of a rail for the drainage system of Figure 1;

Figure 5 is a cross-sectional view of a second embodiment of a rail for the drainage system of Figure 1;

Figures 6 (a) and (b) are a top plan view and cross-sectional view respectively of the rail of Figure 5;

Figures 7 (a) and (b) are a side view and cross-sectional view respectively of a third embodiment of a rail for the drainage system of Figure 1;

Figures 8 (a) and (b) are a side view and cross-sectional view respectively of the rail of Figure 4;

Figure 9 is a side elevation of a drainage system of Figure 1 shown in situ;

Figure 10 is an end elevation of the drainage system of Figure 9;

Figure 11 is an exploded side elevation of a second embodiment of a drainage system according to the invention;

Figure 12 is a side elevation of a drainage system according to the invention in which a carrier pipe is laid level with

a finished floor level;

Figure 13 is an end elevation of the drainage system of Figure 12;

Figure 14 is a side elevation of a drainage system according to the invention in which a carrier pipe is laid with a fall; and,

Figure 15 is an end elevation of the drainage system of Figure 14.

[0019] A first embodiment of a drainage system 10 in accordance with the invention, as illustrated in Figures 1 and 2, comprises a carrier pipe 12 for carrying the collected liquid away. The drainage system 10 also comprises a hollow catchment chamber 14 having an elongate mouth 16 (see also Figure 3 (a)) through which liquid enters the chamber 14, and a body 18 having first and second angled surfaces 20a and 20b that direct the flow of liquid collected in the chamber 14 to an outlet 22. Preferably the body is a triangular shaped body 18. The angled surfaces 20 direct the flow of water and other liquids in a linear course directly to the outlet 22, from where it is forced down a dropper pipe 24. This provides the catchment chamber 14 with an aggressive, self-cleaning capacity. The dropper pipe 24 is connected to the outlet 22 of the catchment chamber 14 for dropping the liquid collected in the chamber 14 directly into the carrier pipe 12.

[0020] Advantageously the catchment chamber 14 is manufactured from a lightweight plastics material such as, for example, medium or low density polyethylene (MDPE or LDPE). This means that the installation process for the drainage system 10 is greatly simplified as the catchment chamber 14 is separate from the carrier pipe 12 and can be lifted and located in situ without mechanical aid. Transportation costs are also greatly reduced.

[0021] Typically the elongate mouth of the catchment chamber 14 is in the form of a slot 16, as can be seen most clearly in Figure 3 (a). Typically the slot 16 is between 5mm to 40mm in width, more typically about 8mm to 27 mm in width. Preferably the triangular shaped body 18 of the catchment chamber 14 has first and second sidewalls 26 which are oriented in a substantially vertical direction in situ. Hence the sidewalls 26 direct the flow of liquid entering the mouth 16 of the chamber 12 directly onto the angled surfaces 20. Preferably the sidewalls 26 have a necked portion 28 adjacent the mouth 16 of the chamber 14 whereby the width of the slot 16 is less than the width of the body 18 of the chamber. Typically the catchment chamber 14 is one of a plurality of catchment chambers, located in situ with the mouths of the chambers provided adjacent to each other end to end so as to form a continuous drainage inlet, as illustrated in Figure 6.

[0022] Preferably when the catchment chamber 14 is located in situ during the installation process, concrete 44 is poured around the chamber 14 to form a monolithic concrete slab which provides strength and support (see Figures 4, 5, 6 and 7). The method of installation will be described further below. The drainage system 10 can withstand even the heaviest loads and adverse storm conditions and yet is constructed of lightweight materials. On the surface, a narrow slot vastly reduces the load placed on the drain itself by the tyre of any vehicle. Instead, the weight is distributed along the paved surface either side of the drain. Below the surface, the "V" design of the catchment chamber allows the concrete to flow under during installation, forming an incredibly strong monolithic slab.

[0023] Preferably the system further comprises a rail 40 made of galvanised steel which is mounted above the mouth of the catchment chamber 14 so as to form an inlet for the catchment chamber. Preferably the rail 40 comprises a pair of elongate members 42 which align with the respective longitudinal edges of the mouth 16 of the catchment chamber 14. In one embodiment, as illustrated in Figure 4, the elongate members 42 each have a plurality of fold-out wings 46 extending from an outside surface of the member for anchoring the grate or rail 40 in the concrete 44 after it has been poured. The pair of elongate members 42 can be made of any suitable depth to suit the particular application.

[0024] Figures 5 and 6 illustrate a second embodiment of a rail 50 made of cast iron which is mounted above the mouth of the catchment chamber 14 so as to form an inlet for the catchment chamber. In this embodiment the rail 50 is in the form of a grate comprising a pair of elongate members 52 which align with the respective longitudinal edges of the mouth 16 of the catchment chamber 14. Between the elongate members 52, mounted substantially parallel thereto is a plurality of intermediate members 54 supported on a series of transverse cross-pieces 56. The spacing between the intermediate members 54 and elongate members 52 is sufficiently small that the heel of a woman's high heeled shoe cannot be caught therein.

[0025] Figure 7 illustrates a third embodiment of a rail 60 made of stainless steel which is mounted above the mouth of the catchment chamber 14 so as to form an inlet for the catchment chamber. In this embodiment the rail 60 comprises a pair of elongate clip members 62 which are received on the respective longitudinal edges of the mouth 16 of the catchment chamber 14. The elongate members clip 62 are temporarily held in place during the installation process on the mouths of the catchment chambers with a PVC extrusion moulded insert. This insert is removed when the concrete has cured.

[0026] All the rails are typically manufactured in 1 m, 2 m or 3 m lengths.

[0027] Preferably the drainage system 10 further comprises a grommet 30 for tapping the dropper pipe 24 into the carrier pipe 12. The grommet 30 is preferably manufactured from EPDM rubber (ethylene propylene diene monomer (M-class) rubber), which is a type of synthetic rubber. The grommets have a tapered and slightly oval shaped design to

counter for falls of zero to 1 in 60. After a hole has been cut in carrier pipe 12 with a hole saw, the grommet 30 is received in the hole. The bottom end of dropper pipe 24 is then inserted into the grommet and is secured with a water-tight seal due to a tapered compression fit. In alternative embodiments, described further below, the grommet 30 may be replaced with a welded socket or slip socket.

[0028] A sub-soil drainage coupling (SSDC) 32 is preferably provided for joining the top end of dropper pipe 24 to the outlet 22 of the catchment chamber 14. The SSDC 32 is a PVC socket with a flare at one end. The male outlet 22 of the catchment chamber 14 has two flat spots on the exterior radius which allows water to flow down the side of the catchment chamber. This water gets collected in the flare of the SSDC 32 and weeps down the two voids between the outlet 22 of the catchment chamber and the SSDC. The socket and catchment chamber 14 are of dissimilar plastics so they are glued together, but care is taken not to glue down the areas where the water weeps.

[0029] Figure 11 illustrates a second embodiment of the drainage system 70 according to the present invention. The system 70 is similar to the previously described drainage system 10, and therefore the similar parts will be identified with the like reference numerals. The drainage system 70 includes a carrier pipe 72, which in this embodiment is in the form of a ribbed stormwater pipe 72. The ribbed pipe 72 has a plurality of welded slip sockets 74 with O-rings provided at spaced intervals along an upper surface of the pipe.

[0030] A plurality of catchment chambers 14 are provided, as in the previous embodiment. Each catchment chamber 14 is provided with its own dropper pipe 24, which is typically manufactured from HDPE or PVC. The dropper pipes 24 are coupled to the outlet 22 of the respective catchment chamber 14 by a coupling 76, which may be secured to the respective components by electro-fusion, push-fit or O-ring.

[0031] A preferred method of installing the drainage system 10 will now be described with reference to Figures 12 to 13 of the accompanying drawings. Figures 12 and 13 illustrate an installation in which the carrier pipe is laid completely level. Assuming the paved surface to be drained is also substantially level, installation commences with the laying of the carrier pipe 12 in a trench 80 of suitable depth. Carrier pipe 12 may be a carrier pipe of conventional design and specifications. The depth of the trench is selected to accommodate the diameter of the carrier pipe 12, as well as the height of the catchment chamber 14 and the thickness of the grate 40. Since there is no variation in height of the catchment chambers 14 above the carrier pipe 12, each catchment chamber may be directly tapped into the carrier pipe using a welded socket 66, without the need for a dropper pipe 24.

[0032] The mouths of the catchment chambers 14 are all easily aligned by the rails 42 of the grate 40, which is placed last on top of the catchment chambers 14. Concrete is then poured into the trench 80, to fill the trench and to form the adjoining pavement. The concrete can flow under the hollow "V" shaped catchment chambers 14 to secure and support the drainage system 10 in position. This allows for a much stronger "monolithic" concrete slab 82 to be laid with less concrete. The wings 46 on the sides of the rails 42 of the grate 40 are also embedded in the concrete, as shown in Figure 4, which helps to transfer most of the load borne by the grate 40 from an applied weight, to the surrounding slab rather than the drainage system 10.

[0033] Figures 14 and 15 illustrate a drainage system 100 which is similar to drainage system 10 of Figures 1 to 10, and therefore the similar parts are identified using the same reference numerals. In the drainage system 100 the dropper pipes 24 are coupled to the carrier pipe 12 using a welded socket 102. The welded socket 102 is heat-welded or otherwise secured to the carrier pipe over the hole. The welded socket 102 receives the bottom end of the dropper pipe 24 therein. The dropper pipe 24 may be secured in the socket 102 with a suitable adhesive. In this embodiment the dropper pipe 24, welded socket 102 and carrier pipe 12 are all made of PVC.

[0034] Essentially the same installation process may be followed if it is desired to lay the carrier pipe 12 with a falling gradient as shown in Figures 14 and 15 for the drainage system 100. The only difference is that in this case the trench is dug somewhat deeper, and dropper pipes 24 are provided to connect the catchment chambers 14 to the carrier pipe 12. To minimise the volume of concrete required, the trench surrounding the carrier pipe 12 and part of the length of the dropper pipes 24 may be back-filled with soil. Then the remainder of the length of the dropper pipes 24 and the catchment chambers 14 are embedded in concrete as shown in Figure 15 to form a "monolithic" slab similar to that of Figure 13.

[0035] The rails 40 are typically provided in 1 metre lengths, whereas the mouths of the catchment chambers are also typically 1 metre in length. By placing the rails 40 so that they meet at the centre of every catchment chamber they aid in supporting, strengthening and keeping the drain perfectly straight during the installation process.

[0036] The catchment chambers 14 are preferably manufactured in a range of sizes to suit different applications:

1 m length	10 mm slot (inside width)	69 mm outlet (inside diameter)
1 m length	20 mm slot (inside width)	90 mm outlet (inside diameter)
1 m length	30 mm slot (inside width)	110 mm outlet (inside diameter)
With cast iron grate:		
1 m length	54 mm slot (inside width)	90 mm outlet (inside diameter)

[0037] The drainage system will also be available prefabricated in 3m lengths, including droppers and carrier pipes, for certain sizes. With a prefabricated version of the drainage system, three catchment chamber are preferably provided in a row with the grates/rails attached. 1 m and 2m sections will also be available. However since most applications will be of considerable length, (and the units are lightweight enough to handle), 3m sections are easier to produce and install and will also result in a straighter drain with less joins. The available sizes are below:

Carrier pipe 100mm PVC - 2 & 3m pre-fab lengths with rail, SSDC, carrier pipe and droppers (Poly welding is used to branch off the carrier pipe)

Carrier pipe 150mm PVC - 2 & 3m pre-fab lengths with rail, SSDC, carrier pipe and droppers (Poly welding is used to branch off the carrier pipe)

Carrier pipe 225mm PVC - 1,2 & 3m lengths with rail & SSDC attached. Installer supplies carrier pipe separately (grommets are used to branch off carrier pipe)

Carrier pipe 300mm PVC - 1,2 & 3m lengths with rail & SSDC attached. Installer supplies carrier pipe separately (grommets are used to branch off carrier pipe)

Carrier pipe 300mm DWC (Double Walled Corrugated) HDPE - 2 & 3m pre-fab lengths with rail, SSDC, carrier pipe and droppers (O-ring sockets which are poly-welded into the carrier pipes are used to branch off. These larger sizes are pre-fabricated in the factory, but the O-ring sockets on the carrier pipes allow the catchment chambers to be removed and slide inside the carrier pipe for transport. The catchment chambers can be slipped into place on site without any need for tools:

400, 500, 600mm DWC HDPE - all the same as above.

[0038] Now that preferred embodiments of the drainage system have been described in detail, it will be apparent that the described embodiments provide a number of advantages over the prior art, including the following:

- (i) Since the catchment chamber is completely remote from the carrier pipe it facilitates a much easier installation process (without mechanical aids).
- (ii) Monolithic slab allows a much stronger concrete slab to be poured with a minimum amount of concrete.
- (iii) The system provides fast and efficient removal of stormwater.
- (iv) Easy to adapt to standard fittings and pipes.
- (v) The catchment chambers are lightweight and easier to transport, with less environmental impact.
- (vi) The carrier pipes can be laid at any prescribed depth and fall according to engineers' specifications. Prior art drains come with a set fall or are level, requiring different segments along the length of the drain.
- (vii) Lightweight construction allows the drainage system to be installed without mechanical aid and facilitates the ability to build the drain on site quickly and efficiently. The lightweight construction thereby also minimising injuries and incidences to the installers of the drainage system(s).
- (viii) The catchment chambers have an aggressive self-cleaning capacity and the entrance of sunlight, which may encourage plant germination, is kept to an absolute minimum.
- (ix) Minimal property and public liability concerns due to the absence of moving parts in the drainage system design.

[0039] It will be readily apparent to persons skilled in the relevant arts that various modifications and improvements may be made to the foregoing embodiments, in addition to those already described, without departing from the basic inventive concepts of the present invention. For example, the shape and configuration of the body of the catchment chambers may be varied from that shown, although the triangular shape and "V" cross-section is particularly advantageous for the reasons previously stated. Therefore, it will be appreciated that the scope of the invention is not limited to the specific embodiments described.

Claims

1. A drainage system for draining stormwater or like liquids from a surface, the drainage system comprising:

a catchment chamber for collecting liquid comprising an elongate mouth through which the liquid enters the chamber and a hollow body having first and second angled surfaces that direct the flow of liquid in the chamber

to an outlet;
a carrier pipe for carrying the collected liquid away; and,
a dropper pipe connected to the outlet of the catchment chamber for directing the liquid collected in the catchment chamber to the carrier pipe.

2. A drainage system as defined in claim 1, wherein the mouth of the catchment chamber is in the form of a slot.
3. A drainage system as defined in claim 2, wherein the hollow body is a triangular shaped body and has first and second sidewalls which are oriented in a substantially vertical direction in situ and are joined together by the first and second angled surfaces to form the hollow body.
4. A drainage system as defined in claim 3, wherein the sidewalls have a necked portion adjacent the mouth of the chamber whereby the width of the slot is less than the width of the body of the chamber.
5. A drainage system as defined in claim 1, wherein the catchment chamber is one of a plurality of catchment chambers, located in situ with the mouths of the chambers provided adjacent to each other end to end so as to form a substantially continuous drainage inlet.
6. A drainage system as defined in claim 1, wherein the system further comprises a rail which is mounted above the mouth of the catchment chamber so as to form an inlet for the catchment chamber.
7. A drainage system as defined in claim 6, wherein the rail comprises a pair of elongate members which are adapted to align with the longitudinal edges of the mouth of the catchment chamber.
8. A drainage system as defined in claim 7, wherein each elongate member has a plurality of wings extending from an outer surface of the member.
9. A catchment chamber for a drainage system for draining stormwater or like liquids from a surface, the catchment chamber comprising:
 - an elongate mouth through which liquid enters the chamber and a hollow body having first and second angled surfaces that direct the flow of liquid in the chamber to an outlet.
10. A catchment chamber as defined in claim 9, wherein the catchment chamber is manufactured from a plastics material.
11. A catchment chamber as defined in claim 9, wherein the mouth of the catchment chamber is in the form of a slot.
12. A catchment chamber as defined in claim 11, wherein the hollow body is a triangular shaped body and has first and second sidewalls which are oriented in a substantially vertical direction in situ, the sidewalls having a necked portion adjacent the mouth of the chamber whereby the width of the slot is less than the width of the body of the chamber.
13. A catchment chamber as defined in claim 9, wherein a dropper pipe is connected to the outlet of the catchment chamber for directing the liquid collected in the catchment chamber to a carrier pipe.
14. A method of installing a drainage system for draining stormwater or like liquids from a surface, the method comprising the steps of:
 - digging a trench for the drainage system;
 - laying a carrier pipe in the bottom of the trench for carrying collected liquid away;
 - connecting a dropper pipe to the carrier pipe;
 - connecting a catchment chamber to the dropper pipe, the catchment chamber comprising a hollow body having first and second angled surfaces that direct the flow of liquid in the chamber to an outlet, the outlet of the catchment chamber being adapted to connect to the dropper pipe for directing the liquid collected in the catchment chamber; and,
 - connecting a rail to the catchment chamber so as to form an inlet for the catchment chamber;
 - pouring concrete around the catchment chamber and underneath the hollow body so as to form a monolithic concrete slab which provides strength and support.

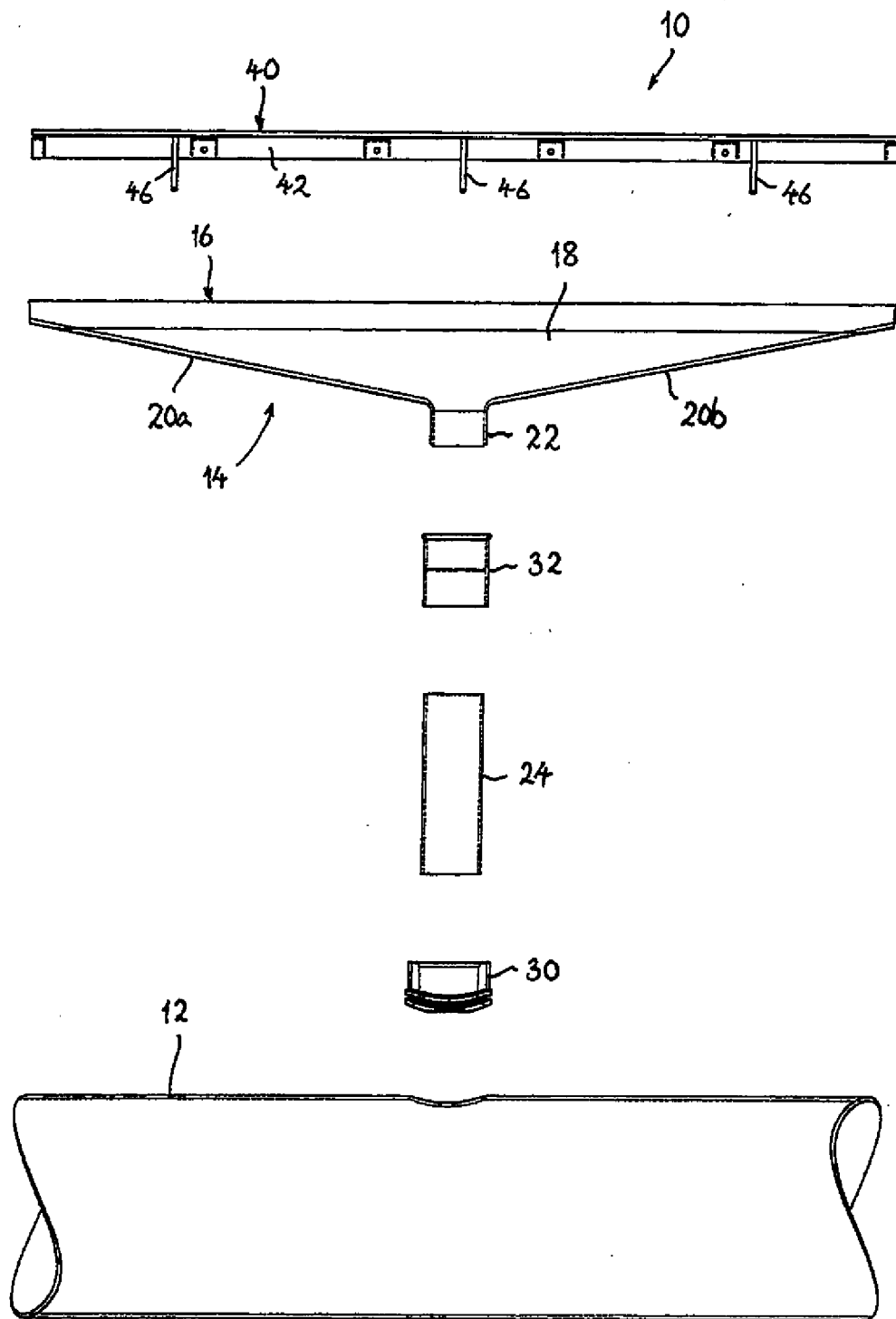


Figure 1

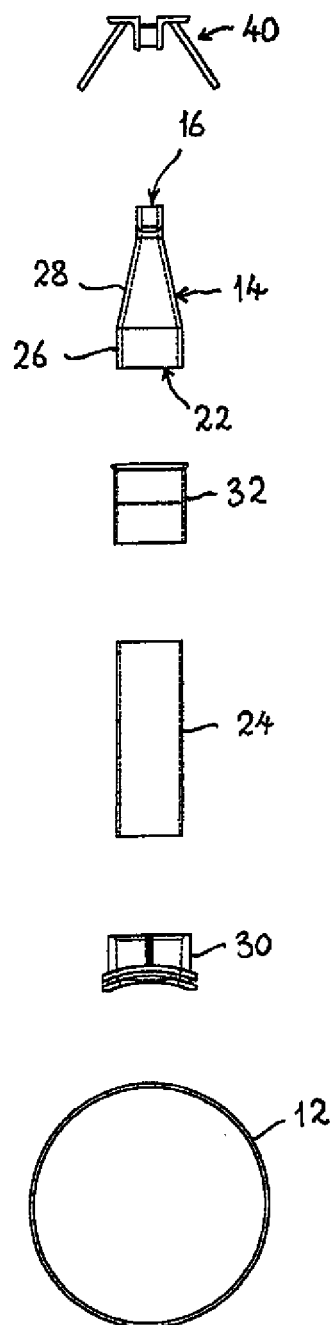


Figure 2

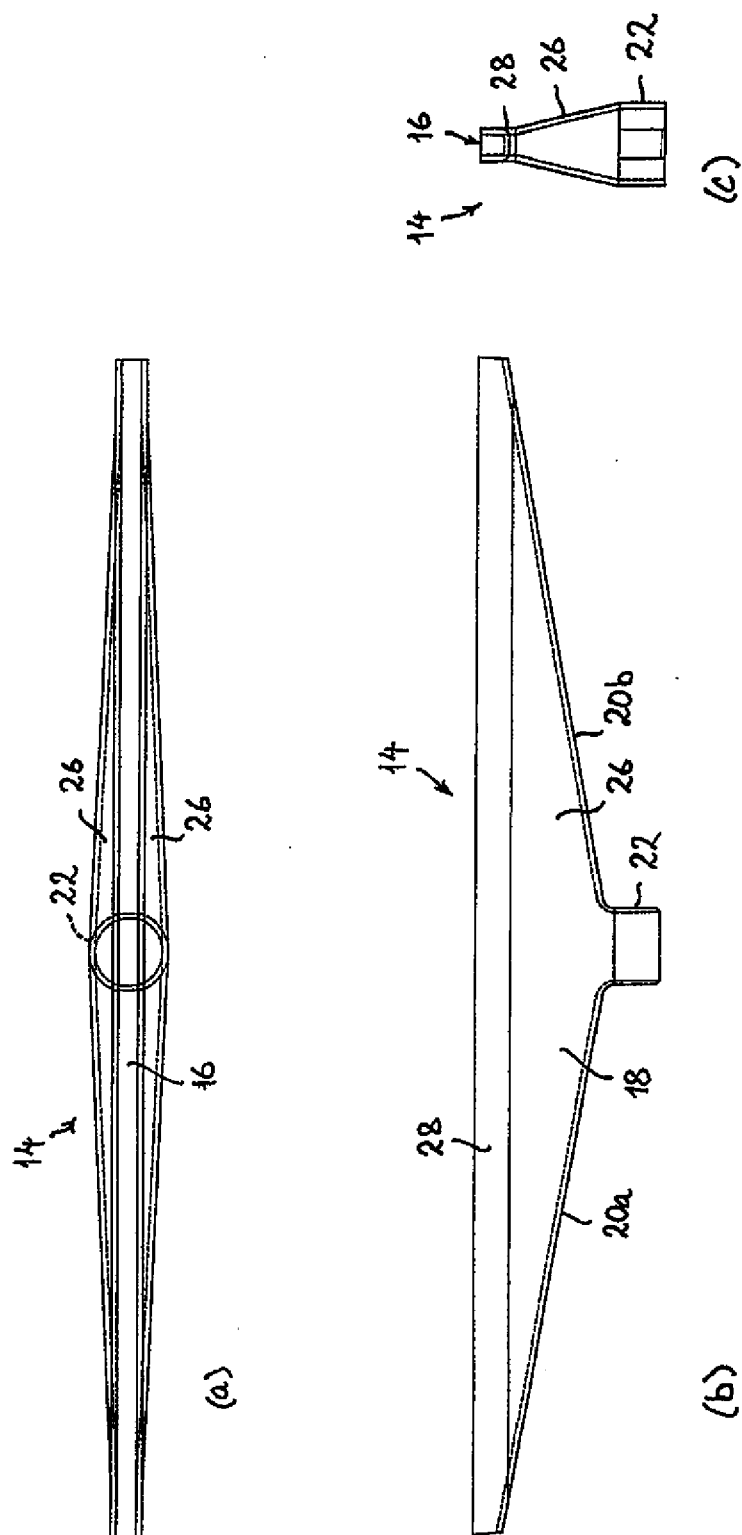


Figure 3



Figure 5

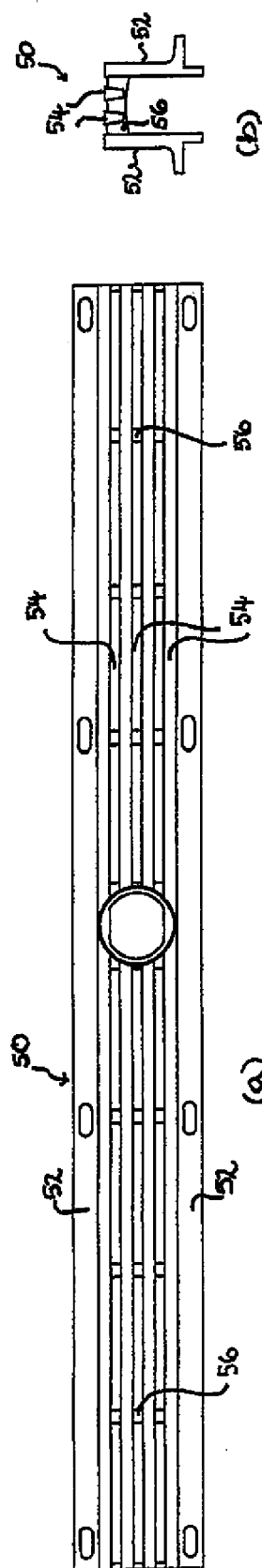


Figure 6

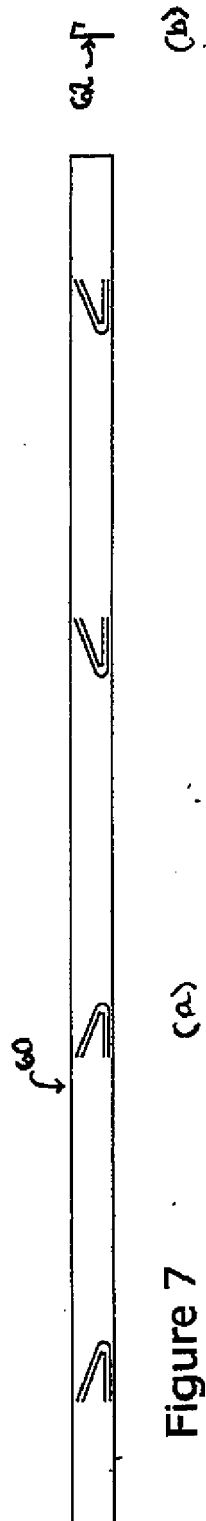


Figure 7

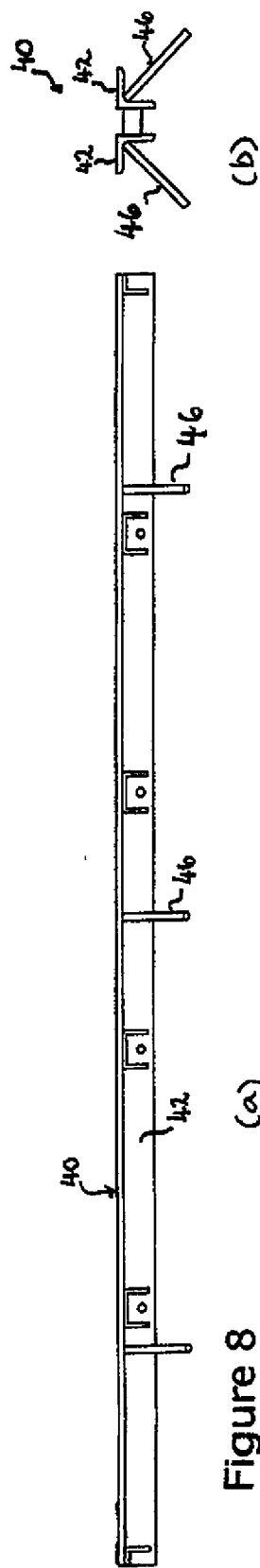


Figure 8

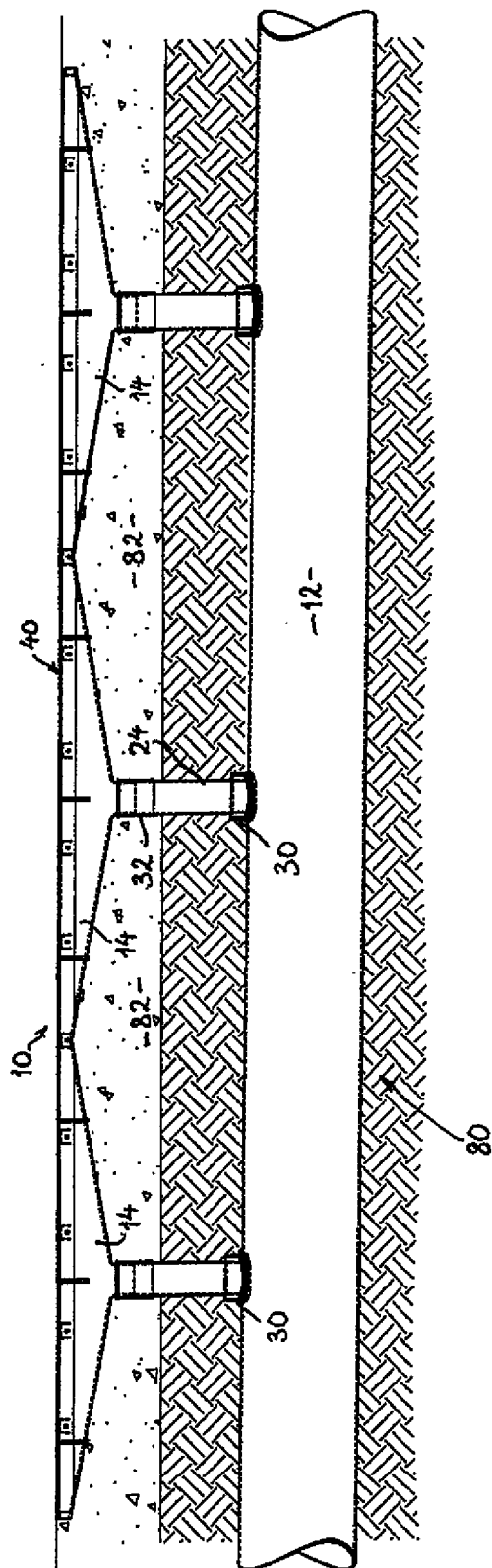


Figure 9

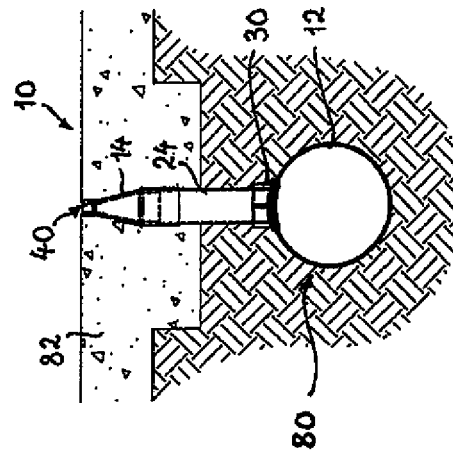


Figure 10

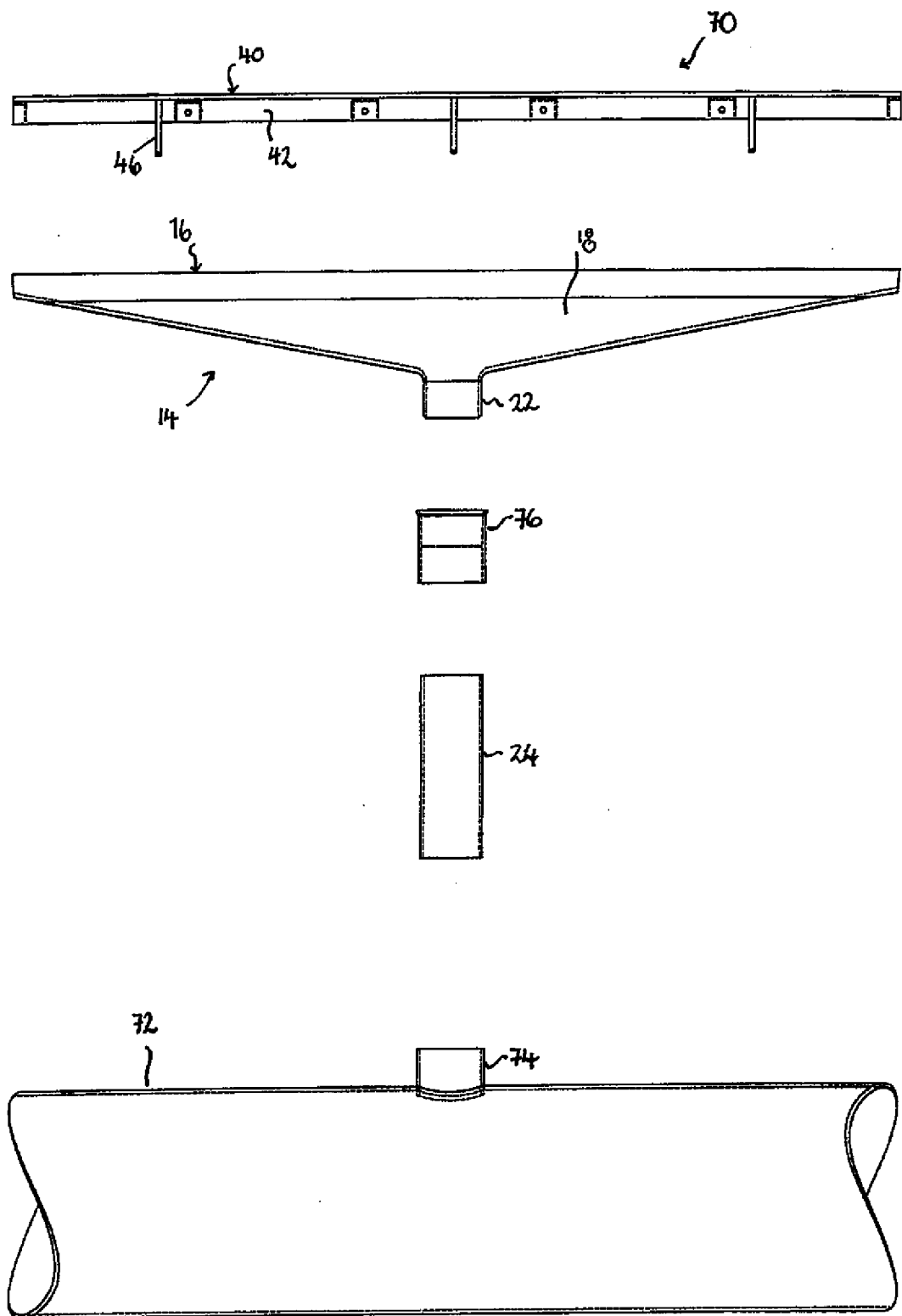


Figure 11

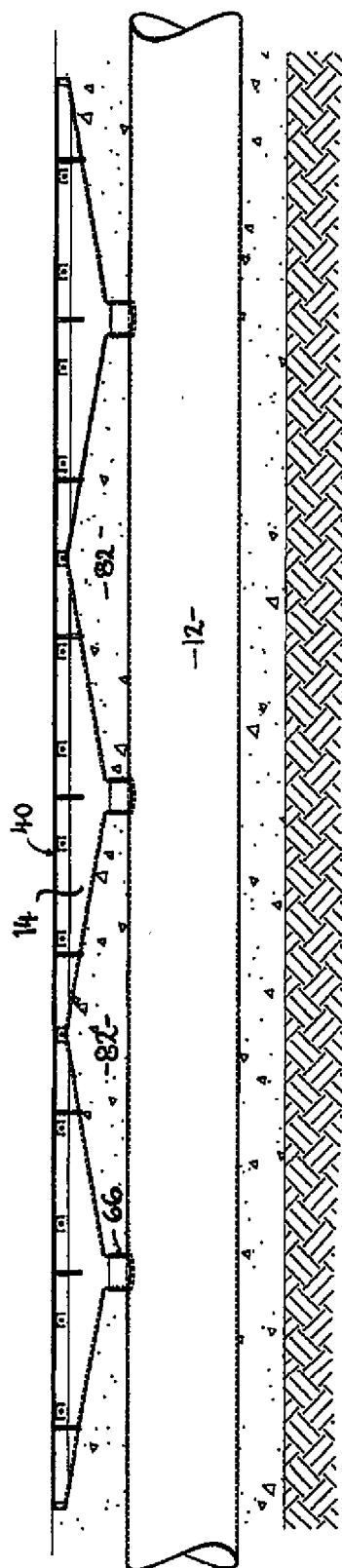


Figure 12

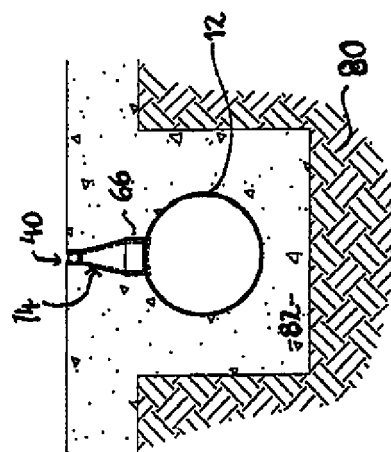


Figure 13

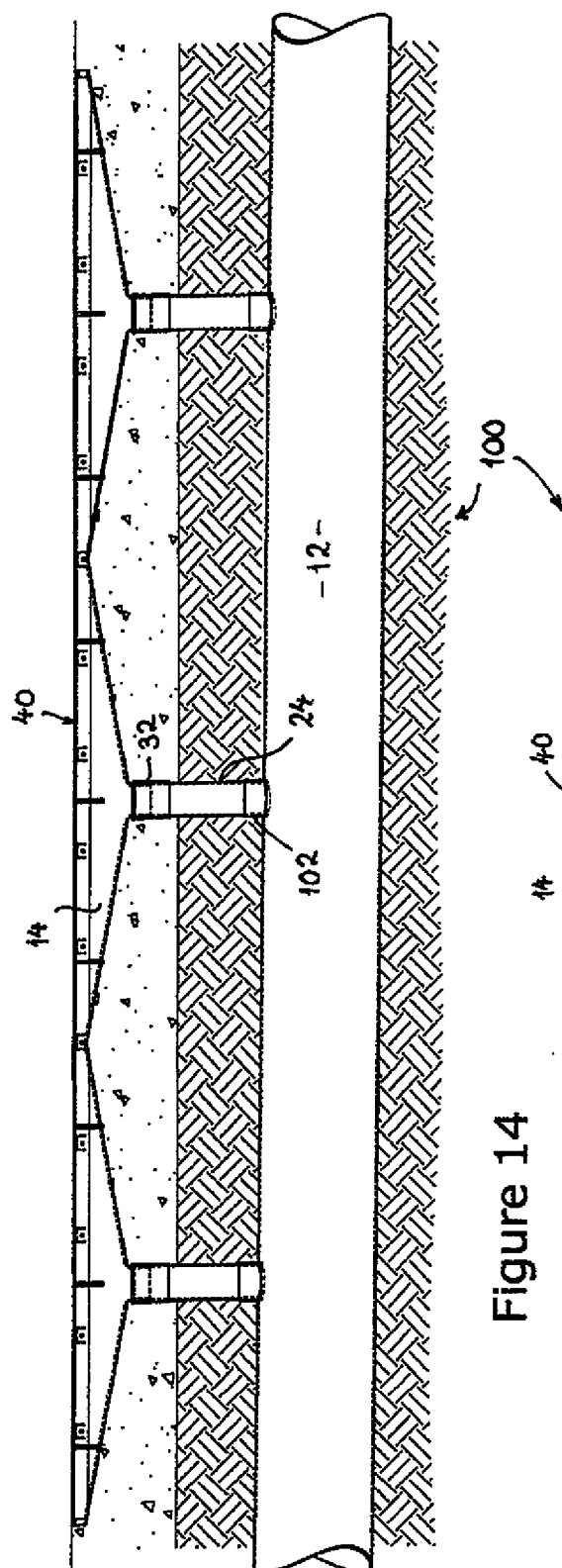


Figure 14

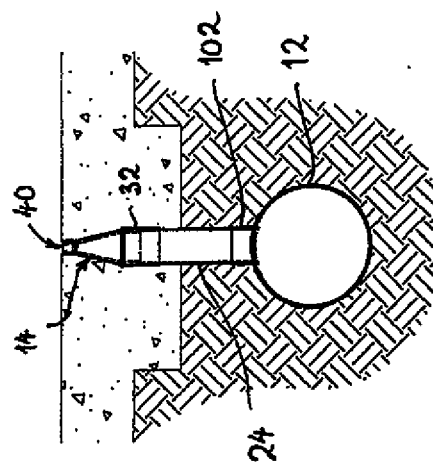


Figure 15