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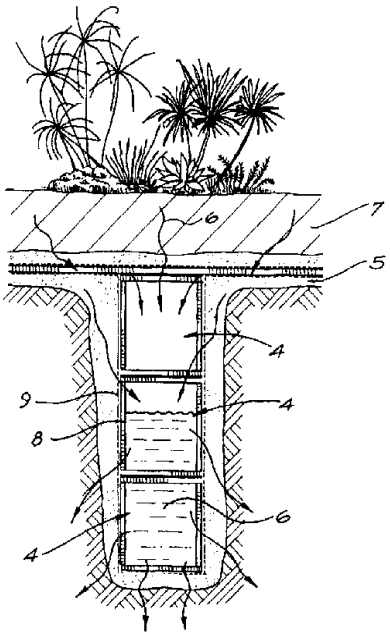
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(54) Title: UNDERGROUND DRAINAGE SYSTEM

(57) Abstract

An underground drainage system comprising piping and storage tanks (4) made from perforated wall modules (8) to form the desired size and configuration, which is wrapped in a water permeable geotextile (9). The system is preferably buried in clean sand (10), whereby rain water and runoff water is directed to flow through the water permeable geotextile (9) through the perforated wall modules (8) and into the piping (4) where the thus filtered water can travel along the piping (4) to flow back through the walls of the piping (4) into the first available strata where the surrounding ground is not saturated.



UNDERGROUND DRAINAGE SYSTEM

The present invention relates to a drainage system and in particular to such a system designed to not only collect excess water but to return purified water to the environment as close to the point of collection as possible. The aerated and pure water allows aerobic neg-entropic activities in the soil horizon both above and in the drainage strata itself.

For many centuries the development of land has involved installation of drainage infra-structure commencing with collection points such as gutters and downpipes, kerbing and guttering, grates and sumps, open or enclosed troughs and canals, detention ponds and others. These primary collection points lead in turn into pipes which in turn feed large pipes or stormwater canals which in turn lead eventually to creeks and rivers and finally the sea. This existing method with its concentration of run off and resultant depletion of the oxygen content of the water, is one of the major causes of water contamination and depletion of flora and fauna on the planet since Roman times.

The continuing urbanisation of the natural countryside which replaced permeable topsoil with impervious surfaces disturbs, alters and contaminates the natural surface water and ground water tables, and results in a dramatic increase in contaminated surface runoff with resulting floods both minor and major, as water which would normally have been absorbed by the soil and flora, is concentrated in man made impermeable channels where the oxygen content of the water is greatly decreased from that of the water in the natural environment .

Water entering into these impermeable anaerobic system undergoes entropic degradation as much litter, oil and other impurities find their way into the system often via kerbsides. The oxygen content of the water which is lowered by mixing organic matter, and pollutants also continually decreases as it passes through the system towards the river or sea.

The accumulation of rubbish and silt in the drainage systems cause the formation of stagnant anaerobic pools which can be breeding grounds for mosquitoes and diseases, especially in open drainage channels.

Much silt and soil also finds its way into drainage systems and furthermore the additional burden on creeks and rivers causes yet further erosion resulting in disastrous siltation lowering of oxygen content of rivers, lakes and eventually the sea. This a major ecological problem of today.

Sportfields are becoming major offenders in ecology. Playing surfaces are becoming unplayable due to the unbalance of water in the first soil horizon. Too much or not enough water result in the degradation of the physical structure of the soil. The resultant retardation of the vegetation induces the use of large amounts of chemicals as a solution to keep the fields grassed. However this increases the contamination of the run off water.

When one compares the abovementioned undesirable situation with the natural undeveloped situation it can be seen that far larger volumes of run-off are being transported far greater distances at an increasing rate.. In natural systems rainwater is filtered through the ground maintaining a healthy oxygen content and is being continually cleansed by such filtration through the soil, sand and rock strata and transport slowly by aquifers.

It is consequently an object of the present invention to more closely emulate natural drainage patterns by provision of an underground system which provide not only for collection and transport of stormwater, but also for return of the stormwater to the environment through porous surfaces at a locality as close as possible to the point of collection.

In one broad form the invention comprises a system comprising storage and/or piping made from module wall panels, said panels having perforations thereon, wherein, in use, the panels are assembled to form the storage and/or piping, and are then wrapped in a geofabric, such that water can flow into and out of the storage and/or piping through the wall panels.

The invention provides an underground drainage system comprising storage and/or piping which are made of porous materials to allow water to flow in all directions through the material, such that in use water permeates from said storage and/or piping into the surrounding earth. Hence embodiments of the present invention have the ability to alter the disruption of the natural water by replacing the impervious entropic man made systems with a neg-entropic natural system, with resultant improvement in quality of flora and fauna.

Permeable topsoil or surface structures with small compaction co-efficient are important to ensure water penetration into the system. In preferred embodiments of the present invention aerobic drainage, electrostatically positions soil fines above hydrophillic geo textile, which surround storage/piping of the present invention. Fine matter is repelled and replaced by larger particles allowing clean oxygenated water to pass therethrough, thus

AUSTRALIAN PATENT OFFICE

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In one broad form the present invention comprises an underground drainage system comprising water storage and/or water piping formed by a plurality of load bearing box like modules, arranged adjacently and wrapped in water permeable geotextile, said modules having external walls with perforations therethrough, such that water can flow into and out of the storage and/or piping through the perforated walls.

The present invention provides an underground drainage system comprising storage and/or piping which are made of porous materials to allow water to flow in all directions through the material, such that in use water permeates from said storage and/or piping into the surrounding earth. Hence embodiments of the present invention have the ability to alter the disruption of the natural water by replacing the impervious entropic man made systems with a neg-entropic natural system, with resultant improvement in quality of flora and fauna.

Permeable topsoil or surface structures with small compaction coefficients are important to ensure water penetration into the system. In preferred embodiments of the present invention aerobic drainage, electrostatically positions soil fines above hydrophilic geotextile, which surround storage/piping of the present invention.. Fine matter repelled and replaced by larger particles allowing clean oxygenated water to pass therethrough, thus

AUSTRALIAN PATENT OFFICE

improving drainage capabilities. This will stop the normal size stratification of soil and thus create the necessary conditions for healthy and fast growth of flora and the resultant proliferation of fauna. Plans thus have the ideal soil conditions, without the need of artificial fertilizer. Fauna and flora proliferate naturally in a balanced manner.

The invention will now be described by way of example with reference to the accompanying drawings in which:

Figures 1, 2 and 3 illustrate cutaway views of drainage systems according to embodiments of the present invention;

Figure 4 illustrates a module of a pipe of one embodiment of the present involvement;

Figure 5 illustrates a further embodiment of the present invention;

Figure 6 illustrates a schematic view of a filter space constructed of discrete modules in accordance to one embodiment of the present invention;

Figure 7 illustrates a drainage cell module suitable for construction of embodiments of the present invention.

Figures 8a, 8b and 8c shown some shapes of tanks or channels according to some embodiments of the present invention;

Figure 9 shows a total water management system for a house utilizing embodiments of the present invention;

Figures 10 and 11 illustrate schematically the use of a holding tank to irrigate trees in parks and median strips;

Figure 12 illustrates one view of a silt collection tank according to one embodiment of the present invention;

Figure 13 illustrates a side view of the silt collection tank of figure 12, and

Figure 14 illustrates a modification of the silt collection tank of figures 12 and 13.

During rain, because of the extensive use of bitumen, concrete and buildings the natural absorption of water into the soil is limited to small areas of parks and gardens.

With existing systems, rainwater flows across the roadways and footpaths which are made of water impermeable material, to flow into gutters through gratings into underground impervious piping. As is obvious the run off carries rubbish through the gratings into the piping. Usually the piping connects with larger diameter piping or open stormwater or drainage channels.

Existing open stormwater channels and underground piping are usually constructed to carry the excess run off to a large body of water such as a lake or the sea. The concrete walls of the conventional open drainage channel is open allowing the entrance of natural organic waste such as leaves, bodies of animals and soil as well as man generated wastes such as plastics. This material is

collected along the entire length of the drain and is deposited in the river systems or finally the sea.

Because of the high concentration of organic material oxygen is depleted from this water and this together with the entrained silt and other pollutants degrade our river systems.

As the concrete walls and the impervious piping are substantially impervious to water, water is carried away form the environment where it enters the channel with minimal opportunity of water entering the immediate ground water.

Further these open channels accumulate litter and silt, as well as stagnant pools of water which are ideal breeding grounds for mosquitoes, rats and other vermin, and disease. Large and deep open stormwater channels also are a danger for small children and animals and potential hazard for vehicular traffic.

Even in the case of an enclosed drainage system utilizing underground pipes, silt, rubbish and pollutants are swept into the pipes via gutter collection points such as drains and the oxygen content of the water is lowered and entrained pollutants are again flushed into our river systems. The concentration of flow by the conventional drainage systems is a major cause of flooding in low areas of the city.

Embodiments of the present invention such as that shown in figure 1, 2 and 3 filter out solids from the water and lessen the reduction of oxygen from the water contained in the pipes of the present invention as compared to the

conventional stormwater channels, due to roughness of the wall surface and the resultant turbulence.

The embodiment shown in figure 1 comprises three layers of porous pipes or tanks (4) buried in a layer of sand (5). Because of the porous nature of the pipes or tanks, water (6) passes from the topsoil (7) into the pipes or tanks (4) where it accumulates or flows to the required collection point. The water can readily flow from the upper pipe to the lower pipe, and out through the walls of the pipe into the groundwater, along the length of the pipe. Any water that travels the length of the pipe is filtered and oxygenated.

One embodiment is shown in figure 4 in which a section of pipe (4) is made up of perforated concrete wall modules (8) having projections (2) which mate within recesses (3) in the inner transverse wall modules (1). Modules of the piping and placed together and wrapped in geofabric.

Whilst any porous material such as concrete can be used, the embodiment shown in figure 1 comprises plastic pipes (4) having perforated double walls (8) to provide structural strength and permeability with a layer of geotextile material (9) covering the entire perforated walls (8). The whole structure is surrounded by clean sand (10). In some circumstances not all the walls need to be perforated.

The embodiment shown in figure 2 utilizes three layers of four porous pipes (4) each layer. The construction of the embodiment is similar to that of figure 1.

The drainage pipes as shown in figure 3 could be constructed from modules of drainage cells (11) as described hereafter with reference to figure 8. These cells (11) are laid beneath the shoulder (12) of a roadway (13). The drainage cell (11) is wrapped in geotextile material (9) which in turn is embedded in clean sand fill (10). The drainage cells (11) assist in carrying water to the holding tank (36) from where water gradually permeates (38) back into the ground water.

A variation of this construction is shown in figure 7 wherein the upper layer (17) of the double walled drainage cell material (11) is co-extensive with the road shoulder (12) although it lies beneath the road shoulder and extends beyond the road shoulder into the adjacent grassed area (14) and forms the upper surface of channel (15).

It may be observed that rectangular section channel (15) has a top and bottom wall and two side walls constructed from modules of double walled drainage cell material (11) and is similarly surrounded by geotextile material (9) and clean sand fill (10).

A permeable or semipermeable tank (16) is also provided beneath the upper horizontal layer (17) of drainage cell material between the roadway (13) and channel (15). This tank is rectangular and is constructed of double walled drainage cell material surrounded by geotextile material and embedded in clean sand. It will be observed that runoff (not shown) from the roadway (13) will flow onto shoulder (12) due to the camber of the road and then filter down through the permeable shoulder and geotextile material into the void between the two walls of drainage cell material (1). This water may then flow through the upper layer (17) of the drainage cell material in the direction depicted by

arrow (18) into the adjacent grassed area (14). In the event that a large downpour is encountered resulting not only in runoff from the road but also saturation of grassed area (14) then the runoff from the road will fill firstly holding tank (16) and then, once holding tank (16) becomes full, channel (15).

Tank (16) will hold water and then slowly allow the water to permeate the surrounding ground. Runoff is therefore contained in an area immediately adjacent that in which it originated and may slowly percolate down through the layers of soil after the initial rain.

In the situation where more runoff is created than can be held by tank (16) then channel (15) accepts further runoff and initially acts as a secondary tank. Channel (15) is however provided with some fall as is the case with conventional stormwater channels so that excessive wetting of the area depicted in figure 6 which exceeds the capacity of tank (16) may result in runoff being transported to an adjacent area (not shown) by channel (15).

Channel (15) is however essentially different from existing stormwater channels in that water contained therein has firstly been filtered prior to entry into the channel and secondly may exit from the channel through the water permeable walls of the channel at the first available location where the surrounding ground is not saturated. In this manner clean water is distributed to the nearest adjacent non saturated location to where the runoff originated.

Figure 6 depicts a method of constructing a drainage channel utilising discrete planar drainage cells (11) to form individual modules having two chambers (19) and (20) therein. It will be appreciated that each module is comprised of a roof (21), a floor (22) and three vertical sides (23). By placing

modules end to end and joining them with joining members (not shown) the open-ended modules may be formed into a conduit of indefinite length. As will be appreciated from figure 1 the conduit formed by the modules is placed in a trench (24) which has previously been lined with clean sand (10) and geotextile material (9). After full assembly of the conduit and the complete wrapping in geotextile material (9), the trench (24) may be backfilled firstly with sand and then, if necessary, other material (not shown).

One form of a drainage cell is shown in figure 7, where the drainage cell (11) is constructed from parallel planar spaced apart walls (25) and (26) with bracing members (27) interposed therebetween. In this example, the apertures (28) in each of walls (25) and (26) are substantially rectangular and are arranged in a checkerboard fashion alternating with substantially rectangular planar load bearing sections (29) of similar size. These load bearing sections are well adapted to support geotextile material. In this embodiment of drainage cell material the apertures (28) in one of the sides are out of register with the apertures in the opposing side hence providing a baffling effect to water passing therethrough of. Such a product may be injection moulded from plastics materials.

The channel modules could be formed of any material, with the walls of any desired thickness having perforations of any desired size.

Preferably the channel modules have two opposed open sides, but could be totally enclosed.

The tanks or piping of embodiments of the present invention can come in modular format and as many modules as desired can be fitted together to

form a pipe as in figure 8a or a tank (39) with two pipes (40) and (41) as shown in figure 8b or as a curved pipe (42) as shown in figure 8c.

As shown in figure 11 the utilization of an embodiment of the present invention greatly increases the collection of rainwater that falls on site. Water is collected either from direct absorption through the ground or being channelled to permeable tanks from hard surface areas.

The use of percolation or holding tanks (36) allow for the gradual permeation of clean water back into the water table as shown in figures 10 and 11, where holding tanks (36) collect water run-off, to be slowly released to the soil adjacent trees or the like to ensure adequate watering thereof.

As shown in figures 12, 13 and 14, a silt or rubbish collection tank (43) can be utilized to feed run off into the storage/piping system. In this case an impervious container (44) is buried in the ground and has an open (45) located at its base, communicating with a filter pipe (45) which has two opposed planar walls having apertures (28) and load bearing sections (29). The apertures (28) of one wall being out of registry with the apertures of the opposed wall. This filter pipe (45) is wrapped in a geotextile material (9).

Lining the base and walls of the container (44) are modules of drainage cells (49) such as those described in figure 7. A geotextile bag (46) sits within the container (44) and its open end (43) is connected to an inlet pipe (48).

Hence run off containing silt and rubbish flows into the bag (46) where the silt and rubbish is retained and the filtered water flows through the drainage

cells (49) into the filter pipe (45). As shown in figure 14 the filter pipe (45) could be made of discrete pipe sections (50).

The present invention therefore provides a drainage collection system which retains and distributes rainwater in an area as close as possible to the area of the rainfall.

It should be obvious that modifications or alterations could be made to the above described invention without departing from the spirit or scope of the present invention.

Claims

1. An underground drainage system comprising water storage and/or water piping formed by a plurality of load bearing box like modules, arranged adjacently and wrapped in water permeable geotextile, said modules having external walls with perforations therethrough, such that water can flow into and out of the storage and/or piping through the perforated walls.

2. An underground drainage system according to claim 1 wherein : said modules comprise two opposed perforated external wall panels with at least two perforated wall panels extending transversely therebetween.

3. An underground drainage system according to claim 3, wherein connection means in the form of recesses and mating pins located on adjacent wall panels to secure adjacent wall panels together.

4. An underground drainage system according any one of the preceding claims, wherein at least the external walls comprise modular wall panels having two planar spaced apart perforated surfaces with a plurality of

AUSTRALIAN PATENT OFFICE

rigid spacer members, therebetween, maintaining said surfaces in a fixed spaced relationship to each other,

said box like modules being connected together to form the storage and piping, with the water permeable geotextile being wrapped around the thus connected box like modules, to cover all of the perforations on the external walls.

5. An underground drainage system according to claim 4, wherein the perforations of each of the two planar spaced apart perforated surfaces are out of registry with the perforations of the other surface.

6. An underground drainage system according to any one of claim 3 to 5, wherein internal walls in the storage and distribution units are formed by said modular wall panels.

7. An underground drainage system according to any one of the preceding claims, wherein the storage and distribution units have a layer of sand surrounding the geotextile.

AUSTRALIAN PATENT OFFICE

8. An underground drainage system according to any one of the preceding claims, wherein piping connected to the storage is formed by said box like modules or said modular wall panels connected end to end and wrapped in geotextile.

9. An underground drainage system according to any one of the preceding claims including a silt trap comprising a water impervious container having an opening in its base;

a layer of said perforated modular wall panels, lining the inner walls and the base of the container and defining a passageway in communication with the said opening in the base of the container;

a bag of water permeable geotextile supported on the modular wall panels; and

and an inlet pipe connected to said bag, such that solids, carried by water into said bag, are retained in said bag and the filtered water passes along the passageway defined by the modular wall panels and out through the opening in the base of the container.

10. An underground drainage system according to claim 9 wherein the opening in base of the container is connected to piping formed by said modular wall panels connected end to end and wrapped in geotextile.

11 An underground drainage system substantially as hereinbefore described with reference to the accompanying drawings.

dated the 11th day of February 1999
Humberto Urriola
by his patent attorney
Paul R. Taylor & Associates

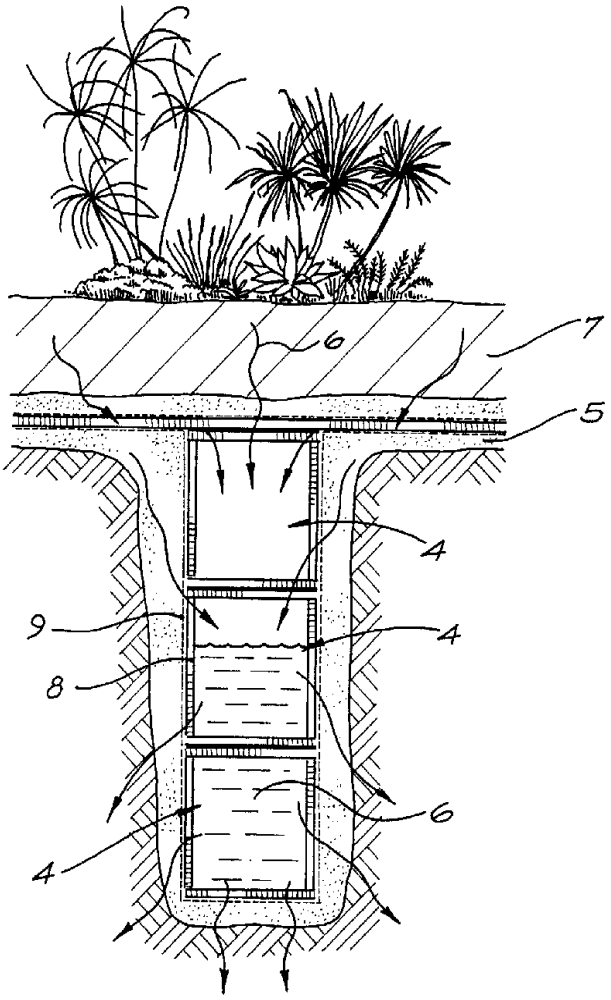


FIG. 1

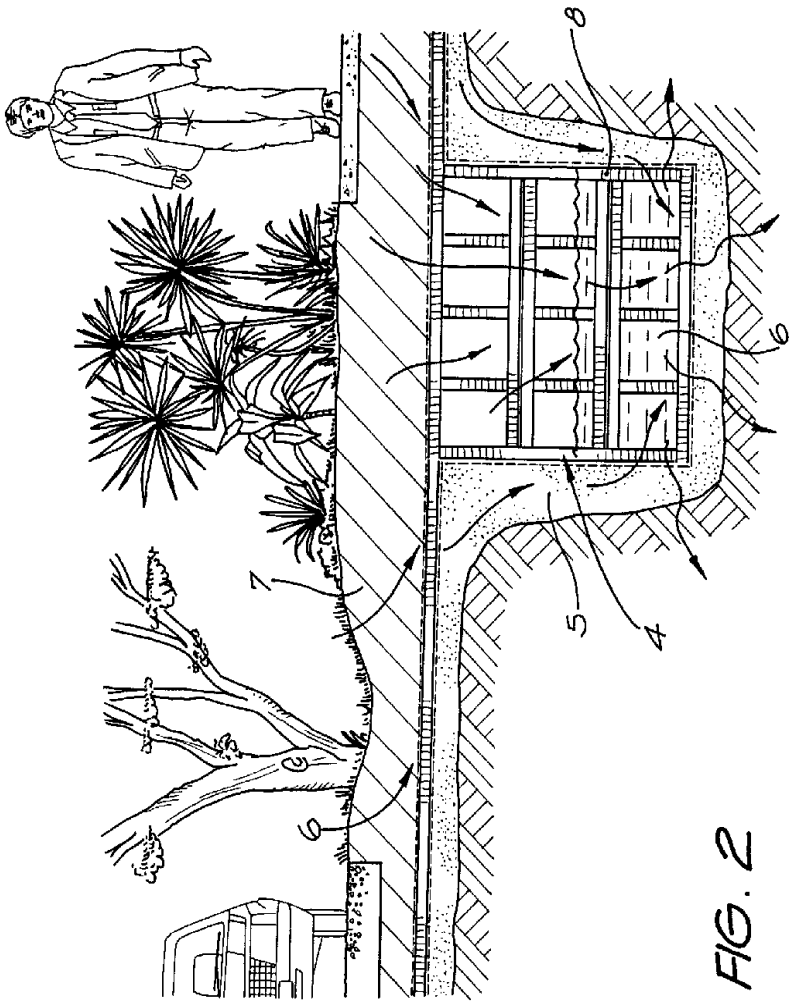


FIG. 2

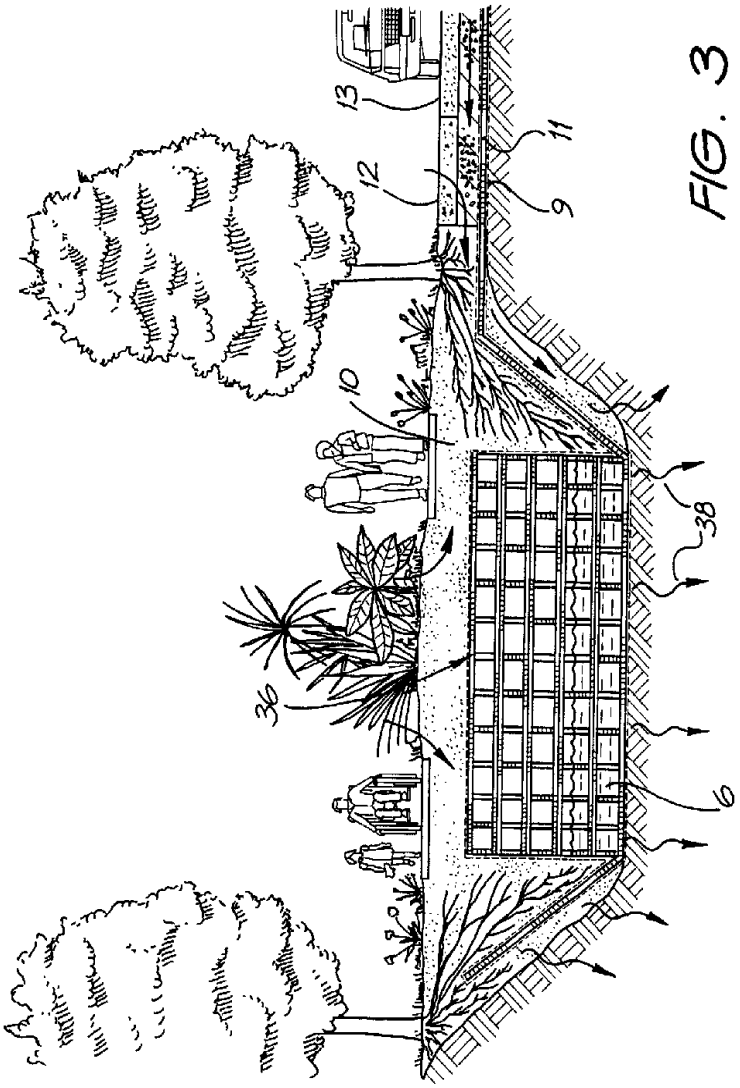


FIG. 3

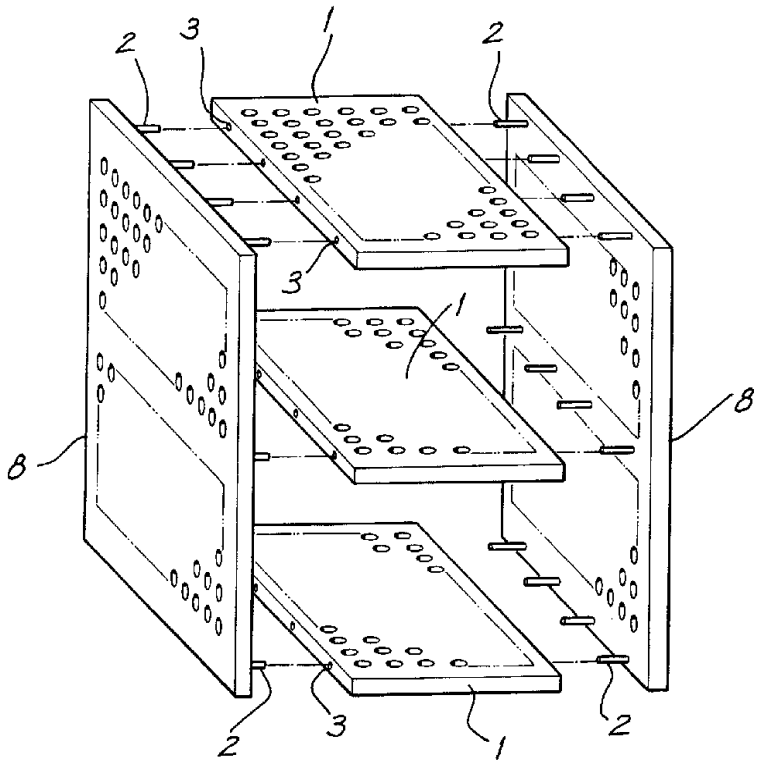


FIG. 4

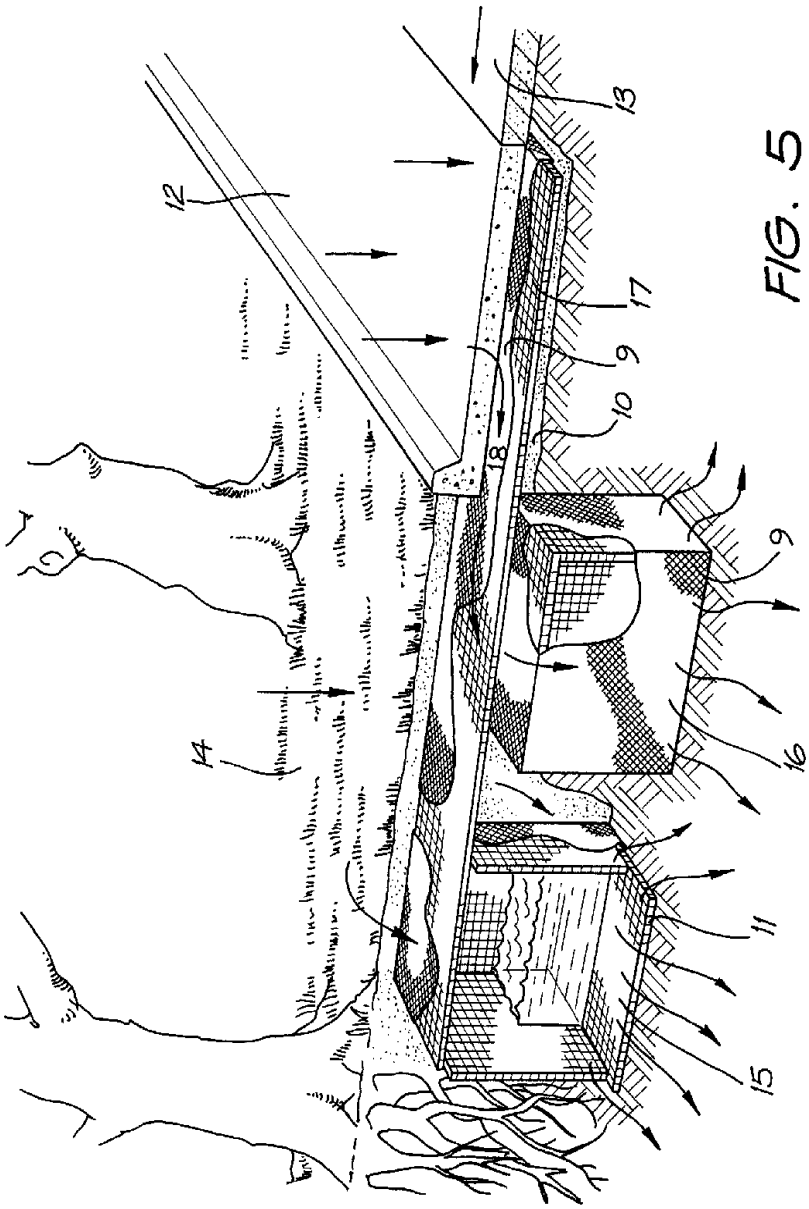


FIG. 5

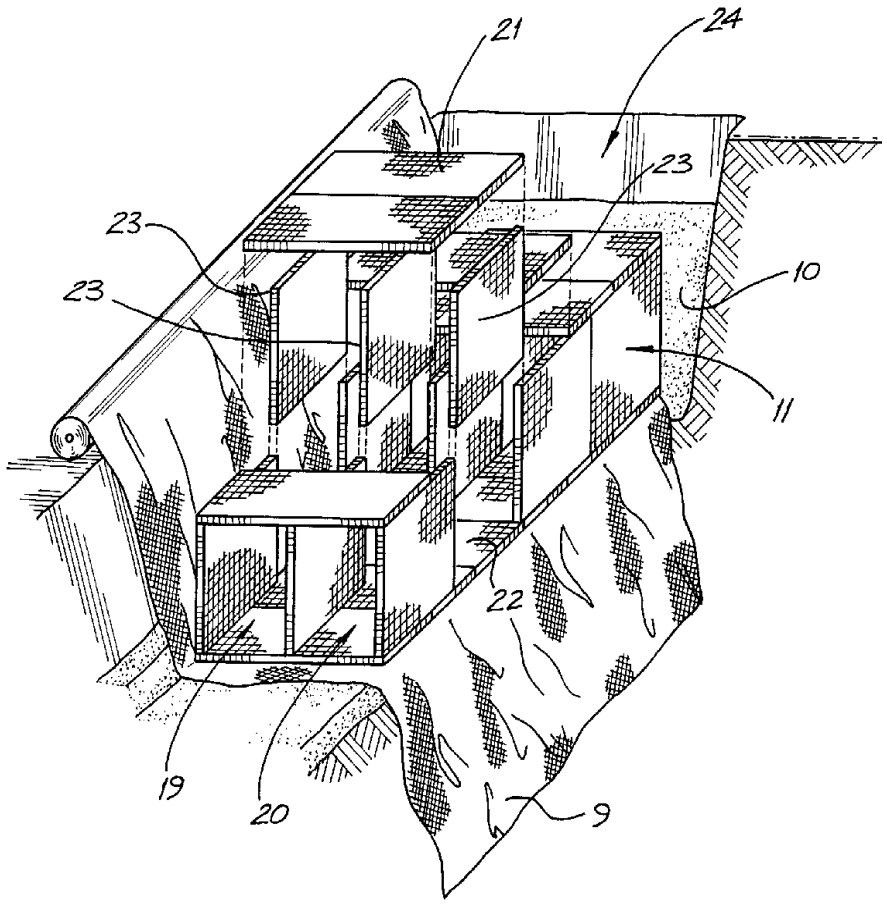


FIG. 6

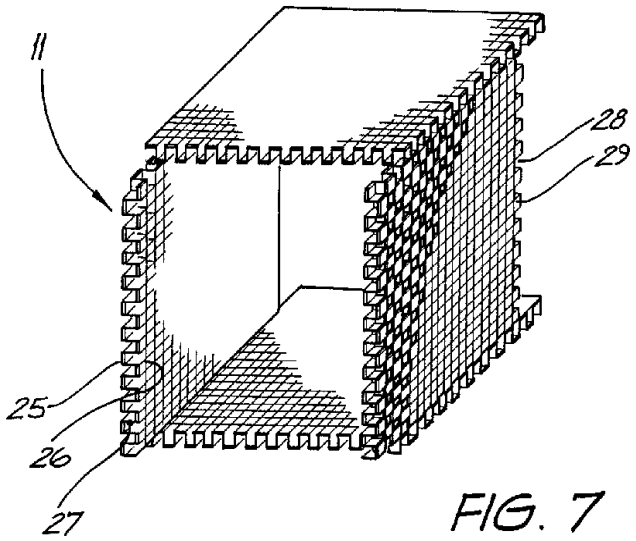


FIG. 7

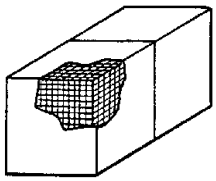


FIG. 8a

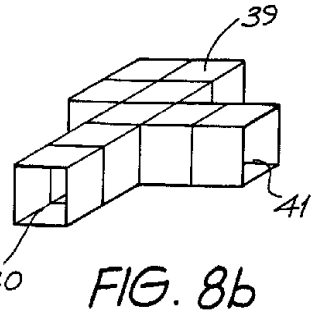


FIG. 8b

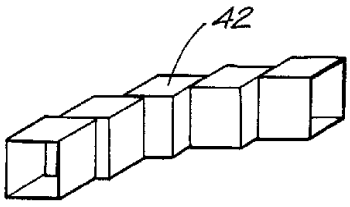


FIG. 8c

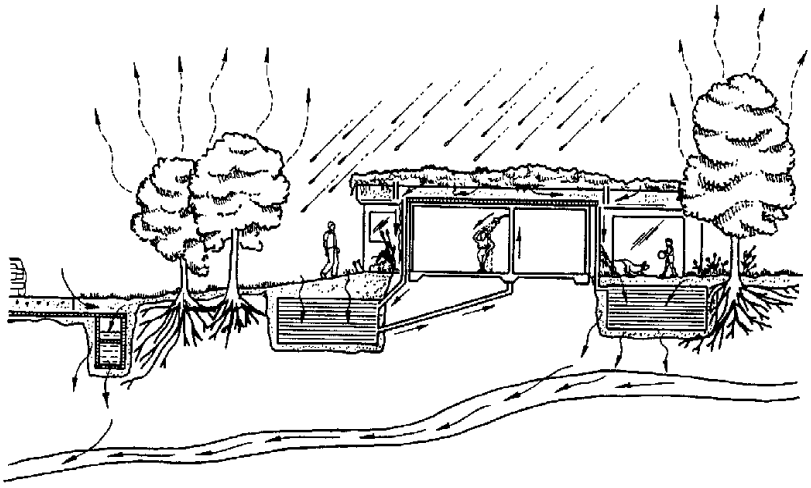


FIG. 9

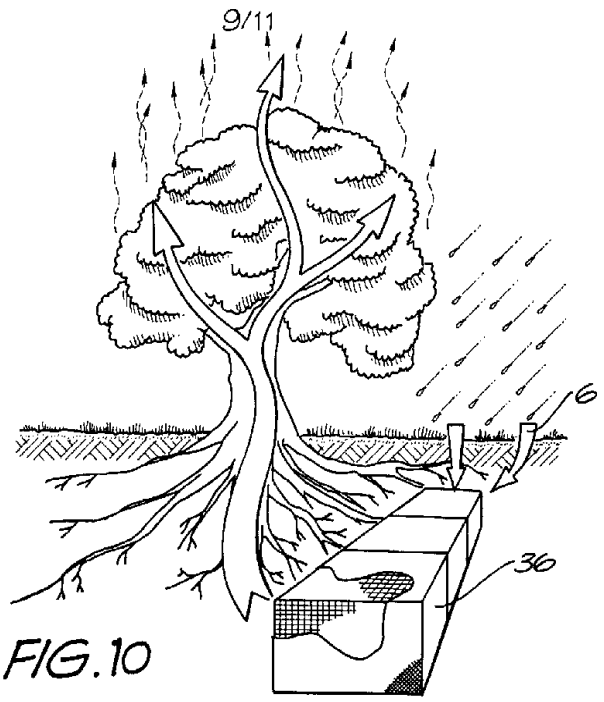


FIG.10

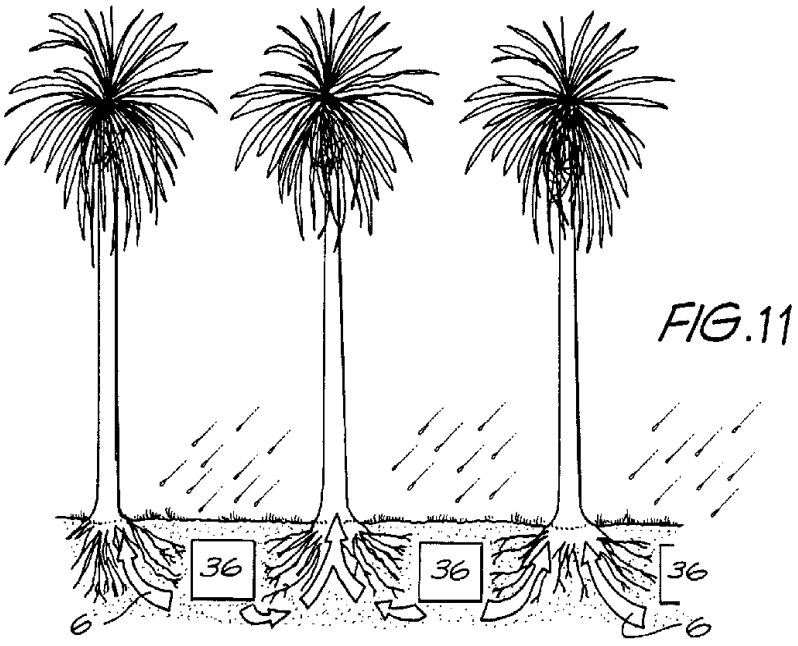


FIG.11

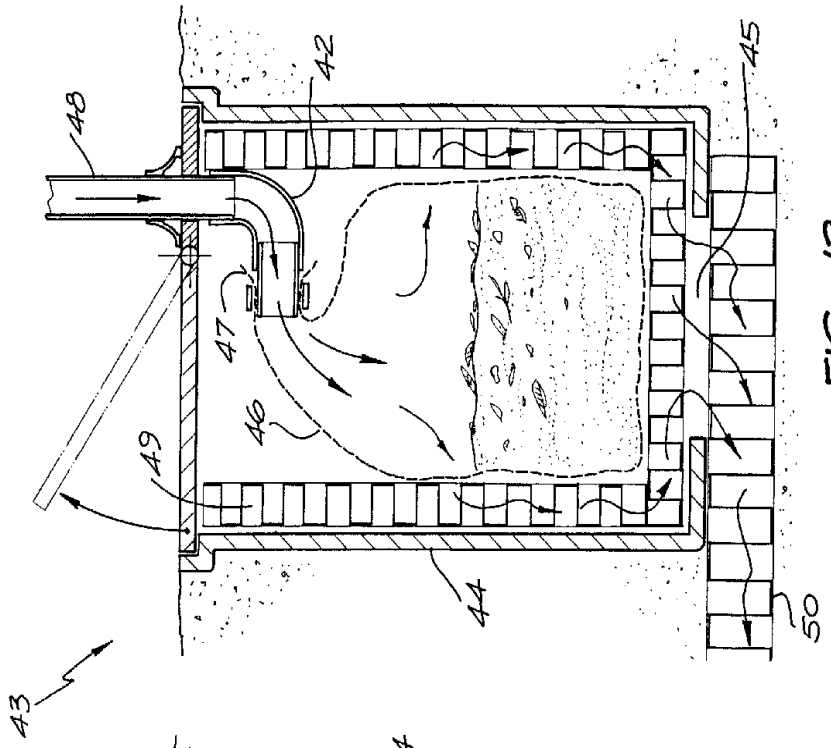


FIG. 13

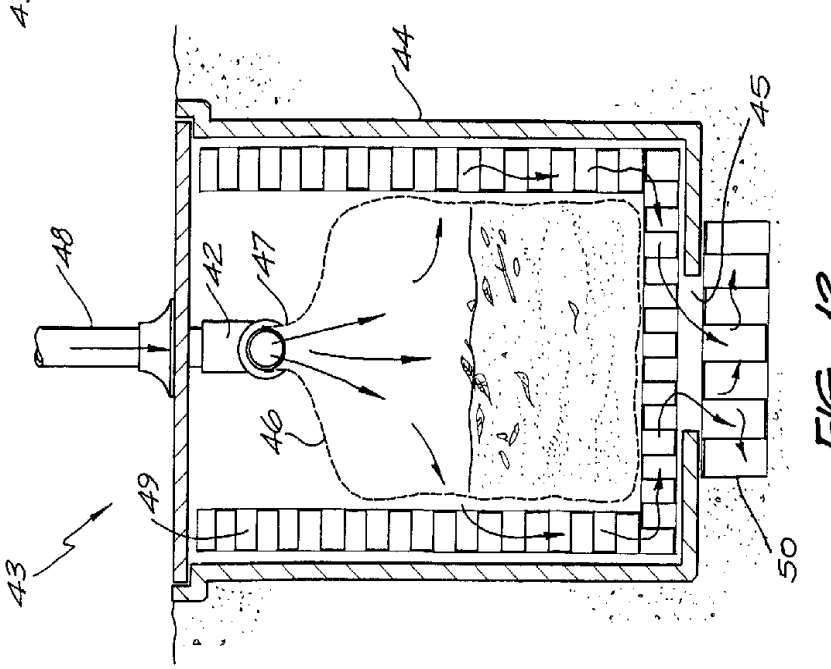


FIG. 12

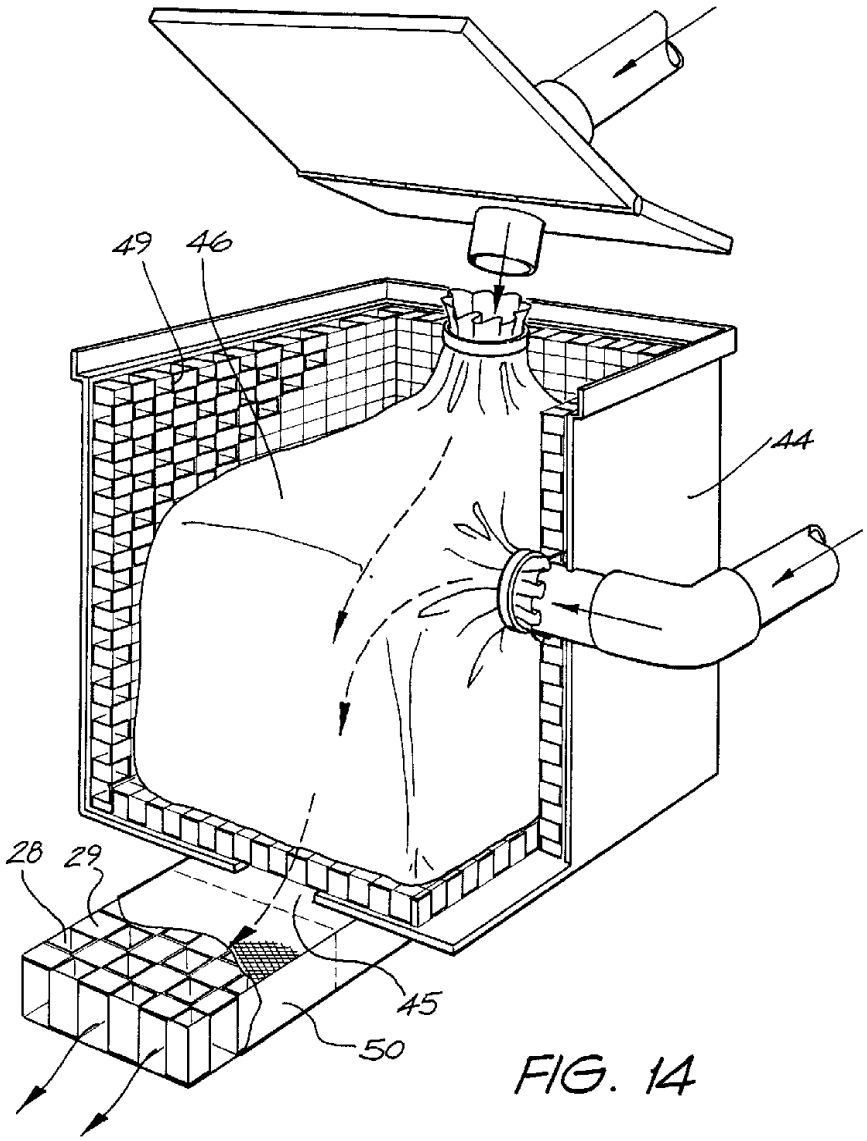


FIG. 14