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(54) **Title:** SURFACE DRAINAGE SYSTEM

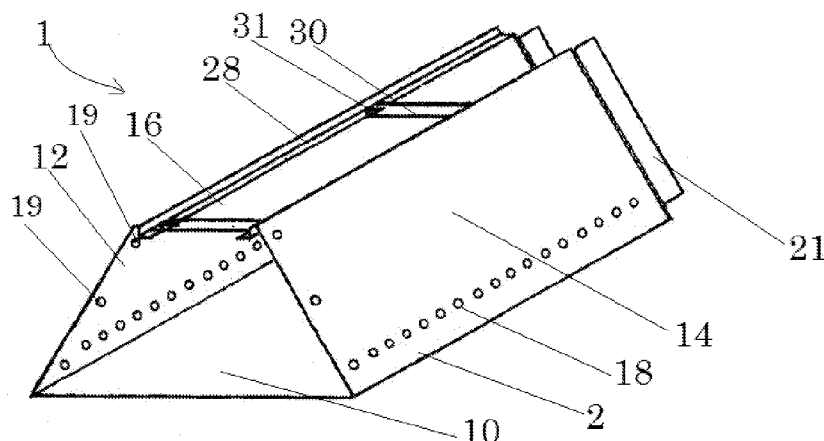


FIGURE 1

(57) **Abstract:** The invention relates to a drainage system for draining away liquid from a surface including a base installed below the surface and a first and second wall. The first and second wall each extend from the base at an acute angle towards one another, defining an opening. In use the base, first wall and second wall form a conduit and liquid can drain into the drainage system through the opening and drain away along the conduit. The configuration of the drainage system assists to maintain the drainage system in place in the surface and acts against deformation from downward forces. The invention also relates to a mesh, grate or other covering for the base, first wall and second wall.

SURFACE DRAINAGE SYSTEM

FIELD OF THE INVENTION

The present invention relates to a surface drainage system, and in particular to surface drainage system for grassed surfaces, sand bunkers and the like.

BACKGROUND TO THE INVENTION

In the specification the invention is described with the example of being used with reference to installation in a grassed surface such as a stadium for playing sport. It is not intended that the invention be limited to use for grassed areas or in stadiums. The invention can be used for drainage of any suitable surface. The suitable surfaces include grassed surfaces, artificial turf or surfaces, soil, artificial surfaces, golf courses and sand bunkers. The invention may be used for any suitable application, not limited to use in sports stadiums.

Grassed sports surfaces need to be kept drained of excess water to be usable. Often these grassed surfaces have little or no fall and due to this water applied to the grass or during rain does not naturally drain away. If pools or soaks of water form, these can be hazardous to sports people on the field and lead to damage of the grass surface. The result may be muddy or bare patches and an uneven surface. After heavy rain the surface may become unusable for several days unless good drainage is used. It is desirable to have the drainage system completely or mostly covered by the grassed surface. The reason for this is to form a safe and cohesive grassed surface for playing sport such as rugby or football. The problem with the drainage systems being covered and obscured from view is that maintenance and other vehicles cannot see the drainage system. When the vehicles are mowing the grass, travelling or parking on the grass it may be that the vehicle passes over or lingers on the drainage system below, which can cause damage. The pipes of existing drainage systems may be just below the surface, for convenience, but making them easy to damage. Repeated damage can cause significant cracks in the pipes and the drainage

system will fail to operate. The shape of existing drainage systems tends to be round pipes which are suitable for draining away water but are vulnerable to cracking if weight is applied from above.

Deep drainage systems are known where large pipes are fitted well below the surface during construction of a grassed surface. The deep drainage pipes have a wide diameter and as such can carry large volumes of water away from the surface. It is advantageous to be able to drain large volumes of water away quickly. However the pipes tend to lift due to the hydraulic forces and so need to be sunk deep into the ground to work well. Deep drainage is more expensive to build, install and maintain than a drainage system close to the surface. Maintenance, in particular, is inconvenient due to the depth of the pipes. Other drainage systems also have the problem of a tendency to lift during rain or heavy flooding due to hydraulic pressures. Water around the drainage system trying to drain away itself can lift up the drainage system. The lifting can cause damage to the pipes and prevents proper drainage of an area. In other applications, such as a sand bunker for a golf course, drainage is difficult and can be costly to install and maintain. Keeping sand dry to enable golf to continue is important to the viability of a golf course. It would be most advantageous to be able to drain sand bunkers quickly and effectively after rain to enable play to resume as quickly as possible.

The inventor has developed an improved surface drainage system that is far more resistant to damage and acts against lifting during heavy rain events and is more readily installed and maintained than known systems.

DICTIONARY

Throughout the specification the term “surface” is used to generally refer to where the surface drainage system is desired to drain. The term may refer to the upper most surface such as including grass of a grassed surface or may include some of the layers under the upper most surface, such as soil and sand, as indicated by the context. The installation may be installed at the level of the

upper most surface of the surface. The installation may be installed in the layers below the upper most surface and it is intended that these installations are installations in the surface.

For clarity, any prior art referred to herein, does not constitute an admission that the prior art forms part of the common general knowledge, in Australia or elsewhere.

It is an object of the present invention to provide a surface drainage system that at least ameliorates one or more of the aforementioned problems of the prior art.

DISCLOSURE OF THE INVENTION

Accordingly, the present invention provides, in a first aspect, a drainage system for draining away liquid from a surface including:

- a base installed below the surface;
- a first wall extending from the base at an acute angle to the base; and
- a second wall extending from the base at an acute angle to the base, the first wall and the second wall extending towards one another to define an opening between the first wall and the second wall,

wherein, in use, the base, first wall and second wall form a conduit and liquid can drain into the drainage system through the opening and drain away along the conduit and the configuration of the drainage system assists to maintain the drainage system in place in the surface and acts against deformation from downward forces.

Preferably, the drainage system is the drainage system for a grassed surface. Preferably, the drainage system is the drainage system for a surface for playing sport. Preferably, the drainage system is the drainage system for a sports stadium. Preferably, the drainage system is installed during construction of the surface. Alternatively, the drainage system may be retrofitted into an existing surface. Existing drainage systems may be replaced with a drainage system

according to the invention. Preferably, the drainage system removes or reduces the need to install a deep drainage system.

The drainage system may be used to drain the surface of a golf course. The drainage system may be used to drain any parts of a golf course. In this form of the invention, the drainage system may be used to drain a sand bunker. The drainage system may include a fall to one end of a sand bunker. A reservoir may be included to collect water that drains from the drainage system. The reservoir may be a tank or similar containment for the water. Preferably, in this form of the invention a pipe is used to carry water from the reservoir to the surface. Water can be piped to the surface for use there. Water may be piped elsewhere to drain away, water grass or for storage for example. A flexible pipe may be used to transport water from the reservoir. The flexible pipe may be a pipe of a diameter of 25 millimetres. A pump may be used to pump water from the reservoir to the surface. The pump may be a centrifugal pump. Air or other gas may be introduced into the fluming to assist with moisture removal.

Preferably, the draining away is the movement of the liquid away from the surface. The draining away may be the draining of the surface of liquid so as to be suitable for playing sport after rain. The draining may be to drain a surface dry suitable for use. The draining away may be to a civil or industrial waste, or sewage system. The liquid may drain away for storage or containment. Any suitable means for removing water from the containment may be used. For example, water may be pumped from the containment for use elsewhere. The liquid may be drained away to tanks. The liquid may be filtered before storage. Preferably, large volumes of water can be quickly drained away from the surface. The drainage may be from one part of a golf course to another. The drainage may be to drain a sand bunker of a golf course.

The liquid may be any liquid it is desired to drain away. Preferably, the liquid is water. The water may be rainwater. The rain water may carry with it material from the surface. The water may be from any source. The liquid may be introduced directly into the drainage system, for example, to flush the drainage system and

to remove any debris or silt. The drainage system may be flushed using any suitable method to remove debris or silt.

The surface may be any surface where it is desired to drain liquid away. Preferably, the surface includes a grassed surface. Preferably, the grassed surface is used for playing sport, including golf. The grassed surface may be used for playing football, for example. Alternatively, the surface may be made from any suitable material. The surface may be an artificial material. The surface may include artificial turf. The surface may be formed of any suitable material where it is desired to drain the surface. The surface may include sand. The surface may include gravel. The surface may be the surface of a sand bunker. The surface may cover the drainage system. The drainage system may be uncovered by the surface. The surface may surround the opening of the drainage system.

The surface may be a surface with underlying material. The surface may be a grassed surface with underlying layers. The grassed surface may include a layer of soil and or a layer of sand below a grassed layer. The surface may be a sand surface. The sand surface may have sand, soil, gravel or a combination of materials below the surface. Preferably, the surface is chosen from the group: a grassed surface; sand surface; gravel surface; or similar. The surface may alternatively refer to only the upper most layer of a surface.

Preferably, the base is a flat base. Preferably, the base is installed substantially horizontally. Preferably, the base is installed below and substantially parallel to the surface. Preferably, the base is installed substantially below and substantially parallel to the surface, or upper most surface layer. Alternatively, the base may include shaping. The base could be installed at an angle, in an alternative form of the invention. Where the base is not substantially parallel to the upper most surface layer the angle of the first wall and the second wall may be configured to extend from the base to be at an acute angle to the horizontal, angled toward one another to form an opening. Slight variations may be made in this regard as to the angles and arrangement of the base and walls.

Preferably, the base is made of a strong material. Preferably, the base is made of a waterproof material. The base may be made of any suitable material. Preferably, the base is made of metal. The base may be made of stainless steel. The stainless steel may be 2 millimetres thick.

Preferably, the first wall is a substantially rectangular shape. Alternatively, the first wall may be a substantially parallelogram shape. The first wall may take any suitable shape. Preferably, the first wall is made of a strong material. Preferably, the first wall is made of a waterproof material. The first wall may be made of any suitable material. Preferably, the first wall is made of metal. The first wall may be made of stainless steel. The stainless steel may be 2 millimetres thick. Preferably, the first wall is made integrally with the base. Preferably, the first wall is at an angle to the base in the range of substantially 40 to 80 degrees. The first wall may be an angle to the base in the range of substantially 50 to 70 degrees. Most preferably, the first wall is at an angle to the base of substantially 60 degrees. Preferably, the base is substantially horizontal and the angle of the first wall is in a range of substantially 40 to 80 degrees to the horizontal. Preferably, the base is substantially horizontal and the angle of the first wall is in a range of substantially 50 to 70 degrees to the horizontal. Preferably, the base is substantially horizontal and the angle of the first wall is substantially 60 degrees to the horizontal. Preferably, the first wall extends from the base at an edge of the base. Preferably, the first wall is an extension of the base bent at an angle toward the second wall.

Preferably, the second wall is a substantially rectangular shape. Alternatively, the second wall may be a substantially parallelogram shape. The second wall may take any suitable shape. Preferably, the second wall is made of a strong material. Preferably, the second wall is made of a waterproof material. The second wall may be made of any suitable material. Preferably, the second wall is made of metal. The second wall may be made of stainless steel. The stainless steel may be 2 millimetres thick. Preferably, the second wall is made integrally with the base. Preferably, the second wall is at an angle to the base in the range of

substantially 40 to 80 degrees. The second wall may be an angle to the base in the range of substantially 50 to 70 degrees. Most preferably, the second wall is at an angle to the base of substantially 60 degrees. Preferably, the base is substantially horizontal and the angle of the second wall is in a range of substantially 40 to 80 degrees to the horizontal. Preferably, the base is substantially horizontal and the angle of the second wall is in a range of substantially 50 to 70 degrees to the horizontal. Preferably, the base is substantially horizontal and the angle of the second wall is substantially 60 degrees to the horizontal. Preferably, the second wall extends from the base at an edge of the base. Preferably, the second wall is an extension of the base bent at an angle to the horizontal toward the first wall. Preferably, the first wall and or the second wall are at an angle to the base in the range of substantially 40 to 80 degrees. Preferably, the first wall and second wall are at an angle to the base of substantially 60 degrees to the horizontal, angled towards one another.

Preferably, the first wall and the second wall are both formed integrally with the base. The base, first wall and second wall preferably form a fluming along which liquid can flow or drain. The base, first wall and second wall preferably form a conduit along which liquid can flow or drain with a substantially quadrilateral shape in cross-section; for example, when a line is drawn across the top from the first wall to the second wall. Preferably, the fluming is substantially of a length in the range 800 to 3000 millimetres. Preferably, the fluming is substantially 2400 millimetres long. Alternatively, the fluming can be any suitable length. Preferably, more than one length of fluming is used. Preferably, a plurality of lengths are used together to form a continuous conduit. Preferably, numerous lengths of fluming are used together to form a long length of fluming, to drain an area. Preferably, a fall is created along the fluming to drain water in a desired direction. Preferably, lengths of fluming are used overlapping one another to form a continuous conduit. Joining pieces may be used. More than one conduit may be used, for example multiple lengths of fluming may be used arranged spaced apart from one another in order that a surface be efficiently drained. Lengths of

fluming may be fastened together. Any suitable fastening may be used. Lengths of fluming may be screw fastened together. Preferably, lengths of fluming are adapted to fit together by inclusion of an overlapping part which can be screw fastened to another fluming.

Preferably, the quadrilateral shape resists downward forces. Preferably, the quadrilateral shape assists to maintain the drainage system in the surface. Preferably, the quadrilateral shape resists lifting of the drainage system, in particular due to hydraulic pressures. Preferably, the first wall and second wall are formed during manufacture to be bent towards one another from the base. The walls may be bent, formed or cast.

Preferably, the first wall is at an angle to the base in the range of substantially 40 to 80 degrees and the second wall is also at an angle to the base in the range of substantially 40 to 80 degrees, the second wall being angled towards to the first wall. Preferably, the first wall is at an angle to the base in the range of substantially 50 to 70 degrees and the second wall is also at an angle to the base in the range of substantially 50 to 70 degrees, the second wall being angled towards to the first wall. Most preferably, the first wall is at an angle to the base of substantially 60 degrees and the second wall is also at an angle to the base of substantially 60 degrees, the second wall being angled towards to the first wall.

Preferably, the first wall is at an angle to the horizontal in the range of substantially 40 to 80 degrees and the second wall is also at an angle to the horizontal in the range of substantially 40 to 80 degrees, the second wall being angled towards to the first wall. Preferably, the first wall is at an angle to the horizontal in the range of substantially 50 to 70 degrees and the second wall is also at an angle to the horizontal in the range of substantially 50 to 70 degrees, the second wall being angled towards to the first wall. Most preferably, the first wall is at an angle to the horizontal of substantially 60 degrees and the second wall is also at an angle to the horizontal of substantially 60 degrees, the second wall being angled towards to the first wall. Most preferably, the base is

substantially horizontal and the angles of the first wall and second wall are substantially 60 degrees to the base and horizontal, facing towards one another.

The first wall and second wall are preferably at a similar angle to the base to the other but facing towards one another. Preferably, the base and the first wall and second wall are the shape of an equilateral triangle with the top cut off. Preferably, the angle to the base of the first wall and second wall is substantially the same. Preferably, the shape and angles of the base, first wall and second wall are beneficial to assist to maintain the drainage system in the ground. Preferably, the drainage system dovetails into the ground to help to maintain the drainage system in the ground. Some soil may be filled over the first wall and or the second wall to assist to maintain the surface drainage system in the ground, and to resist lifting pressures. Preferably, the shape of the base, first wall and second wall acts against lifting of the drainages system due to hydraulic pressure. Preferably, the shape of the base, first wall and second wall acts against deformation due to forces from above. Preferably, the shape of the base, first wall and second acts action deformation caused by vehicles driving over the drainage system. Preferably, the shape of the fluming acts both against lifting from below and crushing from above.

The opening may take any suitable shape. The opening may include one or more covers that substantially cover some parts of the opening. Preferably, the opening is substantially open along its length to maximise drainage into the system. Preferably, the opening between the first wall and second wall is a substantially rectangular shaped opening. The substantially rectangular shaped opening is preferably a substantially long rectangular shaped opening. Preferably, the opening is adapted to be of less width than the base. In one form of the invention the base may be substantially 330 millimetres wide and the opening substantially 152 millimetres wide. The first wall and the second wall may be substantially 185 millimetres high. Preferably, the base, first wall and or second wall are substantially of a length in the range 800 to 3000 millimetres.

Preferably, the base, first wall and or second wall are substantially 2400 millimetres long.

Preferably, one or more ledges are included. Preferably, a grate, mesh or similar can be supported across the opening. Preferably, the ledges support the grate, mesh or similar. Preferably, a pair of ledges is included. Preferably, the first wall and or second wall include ledges. Preferably, the first wall and second wall each include a ledge at the upper edge. Preferably, the or each ledge forms a resting point for a grate, mesh or similar. Preferably, the or each ledge includes a step on which a grate rests. The or each ledge may take any suitable form. Preferably, the ledge is formed integrally with each of the first wall and second wall. The or each ledge may be a folded part of the first wall and second wall. Preferably, the or each ledge is made of stainless steel. The or each ledge may be made of any suitable material.

Preferably, one or more strap or struts are included. Preferably, the or each strut acts to assist to maintain the shape of base, first wall and second wall, relative to one another. It is important that the shape of the surface drainage system is maintained to resist deformation of the surface drainage system in response to downward forces. Preferably, the shape of the fluming is maintained by the or each strut. In particular, during installation the or each strut may assist to prevent the widening of the opening due to the first wall and second wall being moved away from one another and spreading apart. The one or more struts may provide support to a grate, mesh or similar. Preferably, one or more ledges are included and one or more struts are attached to the one or more ledges. Any suitable method of attachment of the strut to the ledge may be used. Preferably, a pair of ledges is included, one on the first wall and one on the second wall and one or more strut is included resting between the ledges and first and second walls. Preferably, the strut is screwed to a ledge. Preferably, a pair of ledges is included and a pair of struts is included in each length of fluming and the ledges and struts provide support to a grate, mesh or similar and help the fluming to keep its shape.

Preferably, in one form of the invention a grate is included resting on or across the top of the first wall and the second wall. Preferably, the grate rests on ledges of the first wall and second wall. Preferably, the grate rests on the ledges of the first wall and the second wall to lie at surface level.

Preferably, in one form of the invention a mesh is included resting on or across the top of the first wall and the second wall. Preferably, the mesh rests on ledges of the first wall and second wall. Preferably, the mesh rests on the ledges of the first wall and the second wall to lie below the surface.

Preferably, the grate forms the fourth side of a quadrilateral shape. The quadrilateral shape is the shape of the conduit in cross-section. Preferably, the quadrilateral shape is beneficial to assist to maintain the drainage system in the ground. Preferably, the quadrilateral shape acts against lifting of the drainage system due to hydraulic pressure. Preferably, the grate with the base, first wall and second wall form an isosceles trapezium. The isosceles trapezium may resist downward pressure and deformation such as from vehicles driving over the drainage system. The particular shape, angles, and configuration of the base, walls and grate together are important features of the invention. Preferably, the base is a wide base and the rest of the fluming narrows to an opening. Preferably, the wide base resists lifting of the fluming due to hydraulic forces.

Preferably, the mesh forms the fourth side of a quadrilateral shape for at least some part of the drainage system. The quadrilateral shape is the shape of the conduit in cross-section. Preferably, the quadrilateral shape is beneficial to assist to maintain the drainage system in the ground. Preferably, the quadrilateral shape acts against lifting of the drainages system due to hydraulic pressure. Preferably, the mesh with the base, first wall and second wall form an isosceles trapezium. The isosceles trapezium may resist downward pressure and deformation such as from vehicles driving over the drainages system. The particular shape angles and configuration of the base, walls and mesh together are important features of the invention. Preferably, the base is a wide base and

the rest of the fluming narrows to an opening at the top. Preferably, the wide base resists lifting of the fluming due to hydraulic forces.

In one form of the invention a mesh may be included. In this form of the invention a membrane may also be included. Preferably, in one form of the invention the mesh is a corrugated mesh. Preferably, the corrugated mesh includes corrugations in the range of 20 to 30 millimetres apart. Preferably, the corrugated mesh guides draining liquid from the surface. Preferably, the corrugated mesh provides strength to the drainage system. The mesh or the membrane may also be used to prevent ingress of soil or other matter into the drainage system. The mesh and membrane may be used together. The surface may cover the drainage system and in this form of the invention it is preferable to use a mesh and membrane. The mesh may be a folded mesh. The folded mesh may take any suitable form. The folded mesh may be a folded stainless steel mesh. Preferably, the folded shape of the mesh resists downward forces applied from above. Preferably, the folded shape of the mesh assists to direct flow of water into the drainage surface system.

In an alternative form of the invention the grate, mesh and membrane may be replaced with a substantially dome shaped part. Preferably, the upper surface of the dome shaped part is domed. Any one or more part of the dome shaped part may be domed. Preferably, a substantially dome shaped part is included lying substantially across at least part of the open top of the first wall and second wall and the domed shape assists to prevent injury of a person on impact from above. The substantially dome shaped part may be adapted to resist downward forces. The substantially domed shaped part may be adapted to assist to prevent injury to a person, should they fall or otherwise contact the surface above the drainage system. The substantially dome shaped part may be a domed mesh to enable water to flow into the drainage system. The substantially dome shaped part may be a plurality of dome shapes repeated along at least part of the length of the drainage system. Preferably, in this form of the invention a domed part is

included lying substantially across at least part of the open top of the first wall and second wall. One or more domed sections may be included along the length of the surface drainage system to act against injury of a person on impact with the surface drainage system from above.

Preferably, the domed shaped part is substantially constructed of mesh. Preferably, the domed shaped part is substantially constructed of folded mesh. Preferably, the mesh is stainless steel mesh. The domed part may be a domed mesh to allow water to flow into the drainage system. Preferably, a domed mesh is included, adapted to fit across the opening. There may be domed mesh parts and other parts which together form a meshed cover for the drainage surface system.

Preferably, the domed mesh includes one or more supports to assist to resist against downward forces. The domed mesh may be domed to any suitable extent. Preferably, the domed mesh is slightly domed. The slight doming directs flow of water without significantly interfering with the overall profile of the drainage system. Preferably, the domed mesh is domed to lie below the top surface of the opening.

Preferably, one or more supports is included to resist downward forces. Preferably, the supports are one or more legs included to support the domed mesh. Preferably, the domed mesh includes two triangular legs which assist to resist downward forces. Preferably, the domed mesh and triangular legs are made integrally. Preferably, the domed mesh and triangular legs are made from folded steel mesh. Alternatively, the triangular legs may be made from other structures, including a steel extrusion. Preferably, one or more triangular support is included below a domed mesh. The triangular supports may be a right-angled triangle in cross-section. Preferably, a pair of supports is included and the supports are substantially a right-angled triangle in cross-section. Preferably, the legs, triangular supports or other forms of legs are formed substantially of mesh. In an alternative form of the invention one or more legs or supports may be included across the opening to assist to resist downward forces. The legs or

supports may be used with a different form of mesh. For example, a corrugated mesh may be included with one or more supports or legs. In this form of the invention the corrugated mesh may resist downward forces due to support of the supports or legs.

Preferably, the configuration of the drainage system significantly improves the ability to resist damage or deformation due to weights being applied. For example, the configuration of the drainage system significantly improves the ability of the drainage system to resist damage or deformation due to the surface being driven over by a vehicle. The configuration of the drainage system resists damage or deformation due to downward forces from above. These downward forces may be due to people walking, running or falling on the surface or directly on the drainage system.

Preferably, the angle of the first wall and the second wall assists to maintain the drainage system in place in the ground. Preferably, the dovetailing of the fluming into the surface significantly resists lifting of the drainage system due to hydraulic forces during flooding or heavy rain.

Preferably, the configuration of the drainage system reduces the incidence of damage during use. Preferably, the drainage system requires minimal maintenance. Preferably, any maintenance of the drainage system can be readily achieved due to it being installed level with or just below the upper layer of the surface. This compares to the difficulty of access to deep drainage systems.

Preferably, one or more drainage holes are included. Preferably, one or more drainage holes are included in the first wall, second wall, and or base. The drainage holes may take any suitable form. Preferably, the drainage holes are substantially circular holes. One or more drainage holes may be included in the base. In this form of the invention water will flow only during heavy rain or flooding events and in low flow of water the water can run out of the drainage holes in the base. A plurality of drainage holes may be included in the base along its length. Preferably, one or more drainage holes are included in the first wall.

Preferably, a plurality of drainage holes are included in the first wall along its length. Preferably, one or more drainage holes are included in the second wall. Preferably, a plurality of drainage holes are included in the second wall along its length. Drainage holes may be included in the base, first wall and second wall. Preferably, the drainage holes in the first and or second wall are positioned approximately one fifth up from the base. Drainage holes are important to resist the lifting action of the flow of water around the drainage system during flood conditions. Preferably, water can flow into the drainage system through the one or more drainage holes during wet conditions and water can drain out of the drainage systems as the water recedes.

Preferably, the drainage holes enable liquid to pass from the surrounding material into the drainage system. For example, during rain water will be soaking into the ground around the drainage system as well as draining into the system through the drainage holes. All of this drainage drains water from the surface. Preferably, the drainage holes assist to reduce pressure forces in the drainage system during heavy rain. Preferably, the drainage holes assist to act against lifting of the drainage system. Preferably, as water flows along the drainage system hydraulic pressure is reduced by the drainage holes allowing water outside the drainage system to flow into the drainage system. Alternative arrangements and of the drainage holes may be made. In a different form of the invention the drainage holes could replace the grate, mesh or similar as the primary or only source of drainage from the surface. The drainage holes may be omitted in some forms of the invention.

Preferably, joint fixing holes are included along an edge of the first and or second wall, towards the opening. Any suitable fixings may be used to connect one piece of fluming to another. The joint fixing holes may be used with screws or the like to secure one piece of fluming to another. In this case there may be an overlapping part or other part adapted at one end and joint fixing holes at the other end of a particular piece of fluming to correspond and assist when fixing multiple pieces of

fluming together. Any suitable position for the drainage holes in the first wall and or second wall may be used.

Preferably, the drainages system substantially resists damage when driven over by a light vehicle. Preferably, the drainage system substantially resists repeated damage from being driven over by a light vehicle. Preferably, the drainage system resists lifting. Preferably, the drainage system substantially resists lifting due to hydraulic pressure due to the shape of the base, first wall, second wall and great together. Preferably, the drainages system dovetails into the ground so as to resist lifting forces.

Preferably, the drainage system can be used for surfaces with little or no fall. Preferably, the drainage system can be installed just below the surface. Therefore can readily replace deep drainage systems in terms of functionality but can be installed at or just below the surface reducing installation time and costs and allowing easy maintenance once installed.

Preferably, in one form of the invention the drainage system can also be used to transport liquids to holding tanks where deep drainage is not possible. The drainage system may drain to a reservoir. A pump may be used to remove the water from the drainage system or reservoir.

Accordingly, the invention also provides in a second aspect a drainage system for draining away liquid from a surface including:

- a base installed below the surface;
- a first wall extending from the base at an angle of substantially 60 degrees to the horizontal;
- a second wall extending from the base at an angle of substantially 60 degrees to the horizontal, the first wall and the second wall extending towards one another to define an opening between the first wall and the second wall; and
- a corrugated mesh or similar lying across the opening,

wherein, in use, the base, first wall, second wall and corrugated mesh form a conduit with a substantially quadrilateral cross-section, and liquid can drain into the drainage system through the corrugated mesh and opening and drain away along the conduit and the quadrilateral shape of the drainage system assists to maintain the drainage system in place in the surface and acts against deformation from downward forces.

Accordingly, the invention also provides in a third aspect a drainage system for draining away liquid from a surface including:

- a base installed below the surface;
- a first wall extending from the base at an angle of substantially 60 degrees to the horizontal;
- a second wall extending from the base at an angle of substantially 60 degrees to the horizontal, the first wall and the second wall extending towards one another to define an opening between the first wall and the second wall; and
- a folded mesh lying across the opening,

wherein, in use, the base, first wall, second wall and folded mesh form a conduit and liquid can drain into the drainage system through the folded mesh and opening and drain away along the conduit and the shape of the drainage system assists to maintain the drainage system in place in the surface and acts against deformation from downward forces.

Accordingly, the invention also provides in a fourth aspect a drainage system for draining away liquid from a surface including:

- a base installed below the surface;
- a first wall extending from the base at an angle of substantially 60 degrees to the horizontal;
- a second wall extending from the base at an angle of substantially 60 degrees to the horizontal, the first wall and the second wall extending

towards one another to define an opening between the first wall and the second wall; and

a mesh including at least one domed part lying across the opening, wherein, in use, the base, first wall, second wall and mesh form a conduit and liquid can drain into the drainage system through the mesh and opening and drain away along the conduit and the shape of the drainage system assists to maintain the drainage system in place in the surface and acts against deformation from downward forces.

Supports may be included as part of the folded mesh or mesh including at least one domed part to assist to resist downward forces.

INDUSTRIAL APPLICABILITY

The drainage system according to the invention can be manufactured industrially and sold to customers for installation into a surface.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in connection with a non-limiting preferred embodiment with reference to the accompanying drawings, in which:

Figure 1 is a perspective view from above of a drainage system for a surface according to a preferred embodiment of the invention;

Figure 2 is a detailed perspective view of the end of the drainage system of Figure 1;

Figure 3 is a detailed perspective view of the joins of one section of drainage system to another section of the drainage system of Figures 1 and 2;

Figure 4 is a front schematic view of the drainage system of Figures 1 to 3, illustrating the angles of the walls to the base;

Figure 5 is a front view of the drainage system of Figures 1 to 4 installed below a grassed surface;

Figure 6 is a detailed perspective view of the corrugated mesh of Figures 1 to 5;

Figure 7 is a plan view of the drainage system of Figures 1 to 5, illustrating joined sections and the corrugated mesh of 6;

Figure 8 is a front view of the drainage system of Figures 1 to 7 installed in a grassed surface, at surface level, with a grate in place;

Figure 9 is a front cross-sectional view of the drainage system of Figures 1 to 7 installed in a sand bunker with a mesh in place; and

Figure 10 is a front cross-sectional view of the drainage system according to a variant to the preferred embodiment of Figures 1 to 5 or 7 and 8, with a folded mesh including a domed surface.

DETAILED DESCRIPTION OF THE DRAWINGS INCLUDING A BEST MODE

Referring to Figures 1 to 9, a preferred embodiment of the invention will be described, and variant thereon, where drainage system 1, includes fluming 2 having base 10 and walls 12 and 14. Base 10 is a flat base of fluming 2 from which each of walls 10 and 12 extend, towards one another.

Opening 16 of fluming 2 is formed between walls 12 and 14 and is of less width than the width of base 10. Drainage holes 18 (only some of which are labelled) of fluming 2 are shown along the length of base 10 and walls 12 and 14. Drainage holes 18 are configured to enable liquid to drain into fluming 2 during wet conditions, or out as conditions dry up, as described in more detail below. Drainage holes 18 are shown as small round holes spaced along the length of walls 12 and 14, at a distance 35 millimetres from the base. Joint fixing holes 19 can be seen along the edge of walls 12 and 14, used to fix lengths of fluming 2 together with screws (not shown). Alternative configurations of holes 18 and 19 could be used, and joint fixing holes 19 could be omitted in one form of the invention.

Drainage system 1 is formed in lengths of fluming 2 with multiple lengths of fluming 2 being used to drain surface 20. In use fluming 2 will be installed to have a slight fall towards where it is desired to direct the flow of water. Lengths of fluming 2 are fitted into one another to overlap where indicated at 21 (refer Figure

1 and 3) and joined using screws (not shown) through joint fixing holes 19 and 3 to form a continuous conduit for draining liquid away. As many or as few lengths of fluming 2 can be used as appropriate for the size of the surface 20 to be drained. Typically, strips of drainage are used across a surface to drain areas to move the water from the surface and away for further drainage or storage, such as for recycling to water the grass at a later date. The arrangement of sections of a drainage system across a sports field leading to tanks is well known in the art.

Referring in particular to Figure 5 drainage system 1 can be seen installed in sub surface 20. Grass surfaces are generally laid on a bed of sand to assist drainage with a soil layer on top on which the grass layer grows. Drainage system 1 lies on sand layer 22 with sand also being built up around walls 12 and 14. Sand layer 22 is used to further assist drainage of water. Soil layer 24 lies over sand layer 22 and over walls 12 and 14, with grass layer 26 over the top. Grass layer 26 grows into soil layer 24 and sand layer 22 drains excess moisture away from the surface, in the usual manner. If surface 20 had a different arrangement of sand, soil and grass or other materials then drainage system 1 could equally be installed in these layers, as appropriate. The invention is particularly applicable to grassed surfaces where sand is included to assist drainage as drainage holes 18 enable water from the sand layer to pass into fluming 2 and flow rapidly away. The flow of water into fluming 2 through drainage holes 18 also acts against lifting of drainage system 1 as the water drains. When the water stops flowing within fluming 2 the pressures will change and moisture can evaporate out of fluming 2 through drainage holes 18 into the sand layer. In this case the sand assists the drainage of the water away from the fluming into the surface. This may be useful to assist to provide the water to a wider area of grass, between rain falls. The grass growing above fluming 2 can take water directly from the flow of water below when available, which also helps to stop the grass drying out. It is preferable to be able to have grass over drainage system 1 to provide a better playing surface.

The weight and accompanying downward pressure of sand, soil and grass on drainage system 1 resists against lifting that may be caused by hydraulic pressure or other fluid caused forces. The particular shape of base 10 and walls 12 and 14 is important as it dovetails fluming 2 of drainage system 1 into surface 20, resisting movement, and in particular upwards movement. Further the dovetailed fluming 2 is firmly installed in surface 20, resisting movement side to side as well as lifting or downward forces, maintaining drainage system 1 in working order for longer.

Ledges 28 can be seen in particular in Figure 2 and 4, to lie along the upper edge of walls 12 and 14. As illustrated ledges 28 are formed from walls 12 or 14. Alternatively, ledges 28 could be formed separately and be attached to walls 12 or 14. Ledges 28 are shown as forming a step shape on which struts 30 can rest. Alternative shapes could be used to support struts 30. Struts 30 are attached using screws 31 (refer Figures 1 and 2) spaced along fluming 2. Both struts 30 and screws 31 are illustrated made of stainless steel; other suitable materials could be used instead. As shown there are two struts 30 used for each fluming section. The number of struts 30 used could be increased or decreased to suit the particular application. Struts 30 are used to prevent walls 12 and 14 from widening during installation.

Mesh 32 has many openings (not shown) through which liquid can pass directly into fluming 2 to drain away through drainage system 1. As can be seen in Figure 6, mesh 32 is corrugated making mesh 32 strongly resistant to downward pressures. Further, the corrugations themselves assist to guide and direct the flow of water; water can enter fluming 2 through mesh 32. Alternative forms of mesh may be used, and could be replaced by a grating. Corrugated mesh 32 is advantageous in that its shape strongly resists downward pressures and deformation due to the corrugations and can also direct water flow in those corrugations during flood situations.

As shown, mesh 32 is configured to fit neatly to cover opening 16 sitting on ledges 28 and supported by struts 30. Mesh 32 is configured to rest on ledges 28 and the dimensions of ledges 28 are such that mesh 32 sits over the top of fluming 2. Mesh 32, as shown, includes edges 34 which rest on the top of fluming 2. Edges 34 are optional and are not shown in all the drawings. Overall mesh 32 is held and supported in place on fluming 2 but can readily be removed for inspection of fluming 2 below or maintenance. It is very useful to be able to readily remove mesh 32 to allow easy inspection of system 1 to see if maintenance is required. The arrangement of corrugated mesh 32 resting on fluming 2 and supported by ledges 28 forms a strong conduit structure, resistant to downward pressures.

The combined parts of fluming 2 and mesh 32 resting on ledges 28 form a quadrilateral shape and in particular an isosceles trapezium. The particular angles can be seen in Figure 4 and these angles have been chosen carefully. Each of walls 12 and 14 is at an angle of 60 degrees to the horizontal base facing toward one another. The base of the isosceles trapezium is of an equilateral triangle having 60 degrees angles, with its top cut off. Use of isosceles trapezium, and in particular one with 60 degree angles, is a strong shape and resistant to downward forces. Drainage system 1 therefore resists damage when heavy weights are applied as the strong shapes reinforces itself and resists buckling or bowing. Surface 20 may be driven over by maintenance vehicles or a lawn mower, for example and the particular shape of drainages system 1 used is strong and resists damage from the weight and action of the vehicle. The angles can be varied somewhat and can be different to one another in other forms of the invention.

Base 10, walls 12 and 14 and ledges 28 are all shown made of stainless steel sheeting, of a thickness of 2 millimetres. Other suitable strong materials such as metals, plastic or other materials or combinations of materials could be used instead. The particular dimensions of drainage system 1 can be readily varied to suit the particular application of the invention. For example, a larger version or

smaller version could be offered for specialist use. As illustrated, base 10 is 330 millimetres wide and each of walls 12 and 14 are 186 millimetres long. The distance between walls 12 and 14 at opening 16 is shown as 152 millimetres wide. Fluming 2 is shown as 2400 millimetres in length but could be any suitable length including in the range of 800 to 3000 millimetres long.

Referring to Figure 8 in particular, drainage system 1 is illustrated, the same as for Figures 1 to 7 except that drainage system 1 is installed at the level of surface 20. All items and reference numerals are the same as for Figures 1 to 7, except mesh 32 and membrane 36 is replaced by use of surface grating 38 in opening 16 (refer Figure 1). In Figure 8 drainage system 1 is illustrated installed in grassed layer 26, but grassed layer 26 does not cover surface grating 38. Surface grating 38 maintains grass layer 26 above fluming 2 and prevents excess debris from entering system 1. Use of surface grating 38 and installation of system 1 level with the surface can be useful for particular applications where it is undesirable to be covered.

Referring to Figure 9 drainage system 1, as shown in Figures 1 to 7, can equally be used on sand, such as to provide drainage to a sand bunker on a golf course. Sand layer 22 is shown all around and over the top of fluming 2 as would be the situation in a sand bunker. Mesh 32 lies across opening 16 (not labelled) under sand layer 22. Water runs readily through sand layer 22, through mesh 32 into fluming 2 to run away in the direction of the fall. During rain water would quickly run into fluming 2. During drier conditions residual moisture would pass through sand layer 22 to run into fluming 2, drying the surrounding sand layer 22. In this form of the invention water may drain due to fall in a particular direction to a reservoir (not shown) at one point in the sand bunker. A pipe (not shown) may be used extending from the reservoir to enable removal of the water. Water may be removed such as for use to water grass elsewhere or be removed for storage or use elsewhere. A pump (not shown) can be used to pump water from the reservoir to dry out the sand bunker. Air or other gas may also be introduced into the system to assist to remove moisture from the sand bunker. The pump and air

drying could also be used for grassed surfaces if desired. Drainage system 1 can also be used to drain the grassed surfaces of a golf course as previously described.

Referring to Figure 10 a different shape of mesh is illustrated. Using the same reference numerals except for folded mesh 132 sitting across opening 16 (not labelled) of walls 12 and 14. Folded mesh 132 includes domed mesh surface 140 and folded mesh supports 142 and 144. Folded mesh 132 is folded into the illustrated shape from a piece of stainless steel mesh. Domed mesh surface 140 is, therefore, formed integrally with folded mesh supports 142 and 144, as a folded mesh brace. It has been found that the shape of the folded form of folded mesh 132 including folded mesh supports 142 and 144 is very useful and strong at resisting downward forces. Folded mesh supports 142 and 144 are folded into a right-angled triangle shape in cross-section. The shape of folded mesh supports 142 and 144 is designed so as to have a strong resistance to downward forces and prevent spreading or other disturbance of walls 12 and 14. As illustrated folded mesh 132 is 150 millimetres across and 28 millimetres high at the centre. Domed mesh surface 140 is a dome of 5 millimetres above folded mesh supports 142 and 144, each 25 millimetres high at the centre. Folded mesh 132 could be used with a different form of drainage system include without the angled walls. However, use of the angled walls and supports strongly resists deformation and so is most advantageous in resisting damage during use. Domed mesh surface 140 is of particular use in a situation where parts drainage system 1 may be contacted by a person. For example, a rugby player may land on domed mesh surface 140 during play with great force. The domed mesh surface of 140 assists to prevent injury of a person on such an impact. Further the overall strength of drainage system 1 resists deformation or damage itself, due to the downward forces of the impact.

Surface 20 is shown in Figure 5 as a grassed surface of sports stadium. The surface of a sports stadium is a very important part of the function and success of a sport stadium business and so careful preparations are made to ensure a

good, usable surface. Drainage system 1 may be installed during construction of the sports stadium or can be retrofitted into an existing grassed surface. Drainage system 1 would be installed with many pieces of fluming 2 joined together to form a long fluming. Several long flumings are used across an area to provide drainage. Different arrangements of drainage system 1 may be used as suitable to the particular application. Drainage system 1 can also be fitted into other surfaces, rather than grass if preferred. The invention however is particularly useful for grassed surfaces as it enables grass to grow over drainage system 1 and take moisture from below, rather than the grass on top of the drainage system struggling for moisture, as in other drainage systems. Drainage system 1 is not limited to being used for sports stadiums but can be used with great benefit on sports playing fields, school grounds, parks, golf courses including sand bunkers, or in fact anywhere drainage is useful. Drainage system can also be used domestically for gardens where drainage is a problem through lack of fall or for businesses to ensure proper drainage of company gardens.

The water could in other forms of the invention be any suitable liquid it is desired to drain away or to capture for containment or storage.

In use, drainage system 1 will be installed and when it rains water will enter through opening 16 and drain away. The drainage may be into the normal drainage or sewerage system, or to tanks for containment or storage. Storage of the water is useful for recycling to water the grass in drier times. As the rain sinks into the ground water seeps through the grass, soil and sand. If there is enough water, water will drain from the sand through drainage holes 18 into drainage system 1 and drain away. As water can pass into fluming 2 the pressure is released from the water outside which helps to resist lifting of drainage system 1. The dovetailed shape of an isosceles trapezium also acts against lifting and better maintains drainage system 1 in surface 20. Even in heavy tropical rains drainage system 1 can quickly carry the water away and prevent the build-up of hydraulic pressures as the water tries to drain away. Water flows along fluming 2 when there are large volumes of water to run into suitable drainage systems such

as flood drains or sewers. When the flow of water is less water can seep out of drainage holes 18 into the surrounding ground. Large volumes of water can be drained away by the drainage system while being installed just below the surface. The drainage system has advantages over expensive deep drainage systems and in that is cheaper to install and easier to maintain.

Overall, the inventor has developed an improved drainage surface system that is resistant to damage, held in place in the ground and readily drains away large volumes of water to keep the surface drained and usable.

It will be apparent to a person skilled in the art that changes may be made to the embodiments disclosed herein without departing from the spirit and scope of the invention in its various aspects.

REFERENCE SIGNS LIST:

1	Drainage System	36	Membrane
2	Fluming	38	Surface grating
10	Base		
12	Wall LH	132	Folded mesh
14	Wall RH	140	Domed mesh surface
16	Opening	142	Folded mesh support
18	Drainage holes	144	Folded mesh support
19	Joint fixing holes		
20	Surface		
21	Overlap		
22	Sand layer		
24	Soil layer		
26	Grass layer		
28	Ledges		
30	Strut		
31	Screw for strut		
32	Corrugated mesh		
34	Edges		

THE CLAIMS:

1. A drainage system for draining away liquid from a surface including:

a base installed below the surface;
a first wall extending from the base at an acute angle to the base; and
a second wall extending from the base at an acute angle to the base, the first wall and the second wall extending towards one another to define an opening between the first wall and the second wall,

wherein, in use, the base, first wall and second wall form a conduit and liquid can drain into the drainage system through the opening and drain away along the conduit and the configuration of the drainage system assists to maintain the drainage system in place in the surface and acts against deformation from downward forces.
2. The drainage system according to claim 1, wherein the surface is chosen from the group: a grassed surface; sand surface; gravel surface; or similar.
3. The drainage system according to claim 2, wherein the surface includes a layer of soil and or a layer of sand below a grassed layer.
4. The drainage system according to any one of claims 1 to 3, wherein the base is installed substantially horizontally below and substantially parallel to the surface.
5. The drainage system according to any one of claims 1 to 4, wherein the first wall and or second wall is at an angle to the base in the range of substantially 40 to 80 degrees.
6. The drainage system according to any one of claims 1 to 5, wherein the first wall and second wall are at an angle to the base of substantially 60 degrees to the horizontal, angled towards one another.

7. The drainage system according to any one of claims 1 to 6, wherein the base, first wall and second wall form a fluming along which liquid can flow or drain.
8. The drainage system of claim 7, wherein a fall is created along the fluming to drain water in a desired direction.
9. The drainage system according to claim 7 or 8, wherein a plurality of lengths of fluming are used overlapping one another to form a continuous conduit.
10. The drainage system according to any one of claims 1 to 9, wherein the base, first wall and second wall form a conduit along which liquid can flow or drain with a substantially quadrilateral shape in cross-section when a line is drawn across the top from the first wall to the second wall.
11. The drainage system according to claim 10, wherein the quadrilateral shape resists downward forces and resists lifting of the drainage system, in particular due to hydraulic pressures.
12. The drainage system according to any one of claims 1 to 11, wherein, the drainage system dovetails into the ground to help to maintain the drainage system in the ground.
13. The drainage system according to any one of claims 1 to 12, wherein some soil is filled over the first wall and or the second wall to assist to maintain the surface drainage system in the ground and to resist lifting pressures.

14. The drainage system according to any one of claims 1 to 13, wherein the shape of the base, first wall and second wall acts against deformation caused by vehicles driving over the drainage system.
15. The drainage system according to any one of claims 1 to 14, wherein a grate, mesh or similar can be supported across the opening.
16. The drainage system according to claim 15, wherein one or more ledges is included and forms a resting point for a grate, mesh or similar.
17. The drainage system according to any one of claims 1 to 16, wherein one or more struts are included to assist to maintain the shape of base, first wall and second wall relative to one another.
18. The drainage system according to claim 17, wherein during installation the or each strut assists to prevent the widening of the opening due to the first wall and second wall being moved away from one another and spreading apart.
19. The drainage system according to any one of claims 1 to 18, wherein a mesh is included resting on or across the top of the first wall and the second wall.
20. The drainage system according to claim 19, wherein the mesh forms the fourth side of a quadrilateral shape for at least some part of the drainage system.
21. The drainage system according to claim 19 or 20, wherein the mesh with the base, first wall and second wall form an isosceles trapezium and the isosceles trapezium resists downward pressure and deformation, such as from vehicles driving over the drainages system.

22. The drainage system according to any one of claims 19 to 21, wherein the mesh is a corrugated mesh and the corrugated mesh guides draining liquid from the surface.

23. The drainage system according to any one of claims 1 to 21, wherein a folded mesh is included and the folding of the mesh resists downward forces applied from above.

24. The drainage system according to any one of claims 1 to 21, wherein a substantially domed shaped part is included lying substantially across at least part of the open top of the first wall and second wall and the domed shape assists to prevent injury of a person on impact.

25. The drainage system according to claim 24, wherein the domed part is a domed mesh to allow water to flow into the drainage system.

26. The drainage system according to claim 24 or 25, wherein the domed part is a domed mesh and includes one or more supports to assist to resist against downward forces.

27. The drainage system of claim 26, wherein a pair of supports are included and the supports are substantially a right-angled triangle shape in cross-section.

28. The drainage system according to any one of claims 1 to 27, wherein one or more supports is included across the opening to assist to resist downward forces.

29. The drainage system according to any one of claims 1 to 28, wherein one or more drainage holes are included, in the first wall, second wall, and or base.

30. The drainage system according to claim 29, wherein the drainage holes in the first and or second wall are positioned approximately one fifth up from the base.

31. The drainage system according to claim 29 or 30, wherein the drainage holes enable liquid to pass from the surrounding material into the drainage system.

32. The drainage system according to any one of claims 29 to 31, wherein as water flows along the drainage system hydraulic pressure is reduced by the drainage holes allowing water outside the drainage system to flow into the drainage system.

33. The drainage system according to any one of claims 1 to 32, wherein joint fixing holes are included along an edge of the first and or second wall towards the opening.

34. The drainage system according to any one of claims 1 to 35, wherein the drainage system can be used for surfaces with little or no fall.

35. The drainage system according to any one of claims 1 to 34, wherein the drainage system is the drainage system for a surface for playing sport, including golf.

36. The drainage system according to any one of claims 1 to 35, wherein the drainage system drains to a reservoir and a pump can be used to remove the water.

37. A drainage system for draining away liquid from a surface including:
a base installed below the surface;
a first wall extending from the base at an angle of substantially 60 degrees to the horizontal;

a second wall extending from the base at an angle of substantially 60 degrees to the horizontal, the first wall and the second wall extending towards one another to define an opening between the first wall and the second wall; and

a corrugated mesh or similar lying across the opening,

wherein, in use, the base, first wall, second wall and corrugated mesh form a conduit with a substantially quadrilateral cross-section, and liquid can drain into the drainage system through the corrugated mesh and opening and drain away along the conduit and the quadrilateral shape of the drainage system assists to maintain the drainage system in place in the surface and acts against deformation from downward forces.

38. A drainage system for draining away liquid from a surface including:

a base installed below the surface;

a first wall extending from the base at an angle of substantially 60 degrees to the horizontal;

a second wall extending from the base at an angle of substantially 60 degrees to the horizontal, the first wall and the second wall extending towards one another to define an opening between the first wall and the second wall; and

a folded mesh lying across the opening,

wherein, in use, the base, first wall, second wall and folded mesh form a conduit and liquid can drain into the drainage system through the folded mesh and opening and drain away along the conduit and the shape of the drainage system assists to maintain the drainage system in place in the surface and acts against deformation from downward forces.

39. A drainage system for draining away liquid from a surface including:

a base installed below the surface;

a first wall extending from the base at an angle of substantially 60 degrees to the horizontal;

- 5 a second wall extending from the base at an angle of substantially 60
degrees to the horizontal, the first wall and the second wall extending
towards one another to define an opening between the first wall and the
second wall; and
a mesh including at least one domed part lying across the opening,
- 0 wherein, in use, the base, first wall, second wall and mesh form a conduit and
liquid can drain into the drainage system through the mesh and opening and
drain away along the conduit and the shape of the drainage system assists to
maintain the drainage system in place in the surface and acts against
deformation from downward forces.

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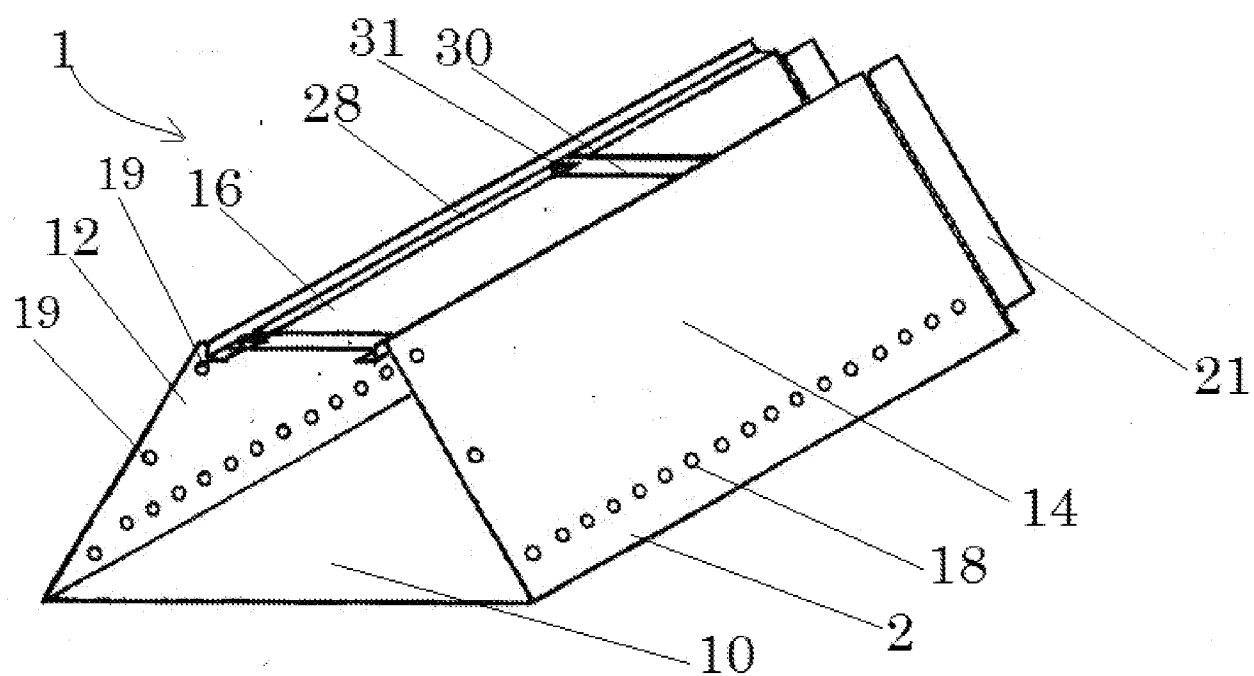


FIGURE 1

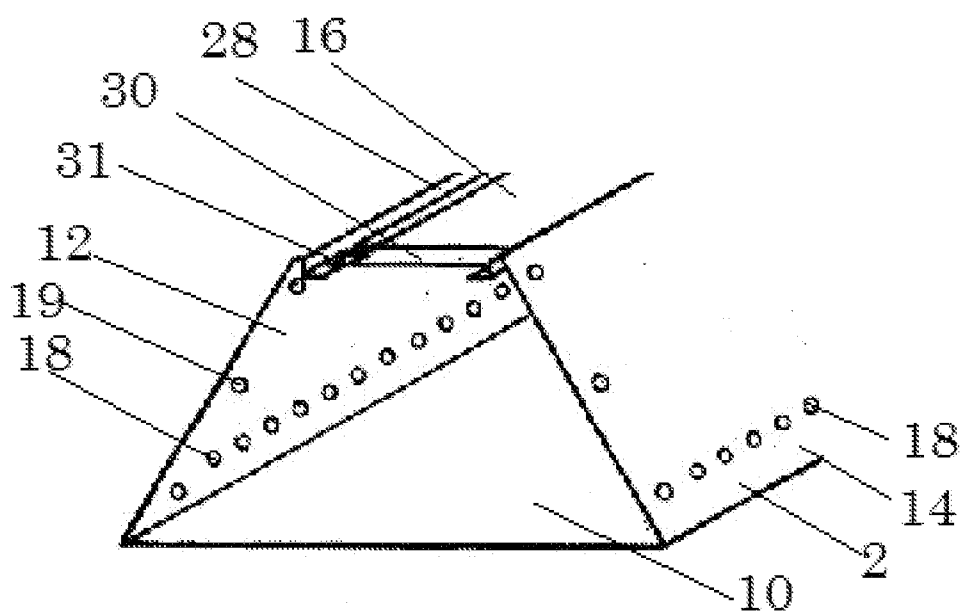


FIGURE 2

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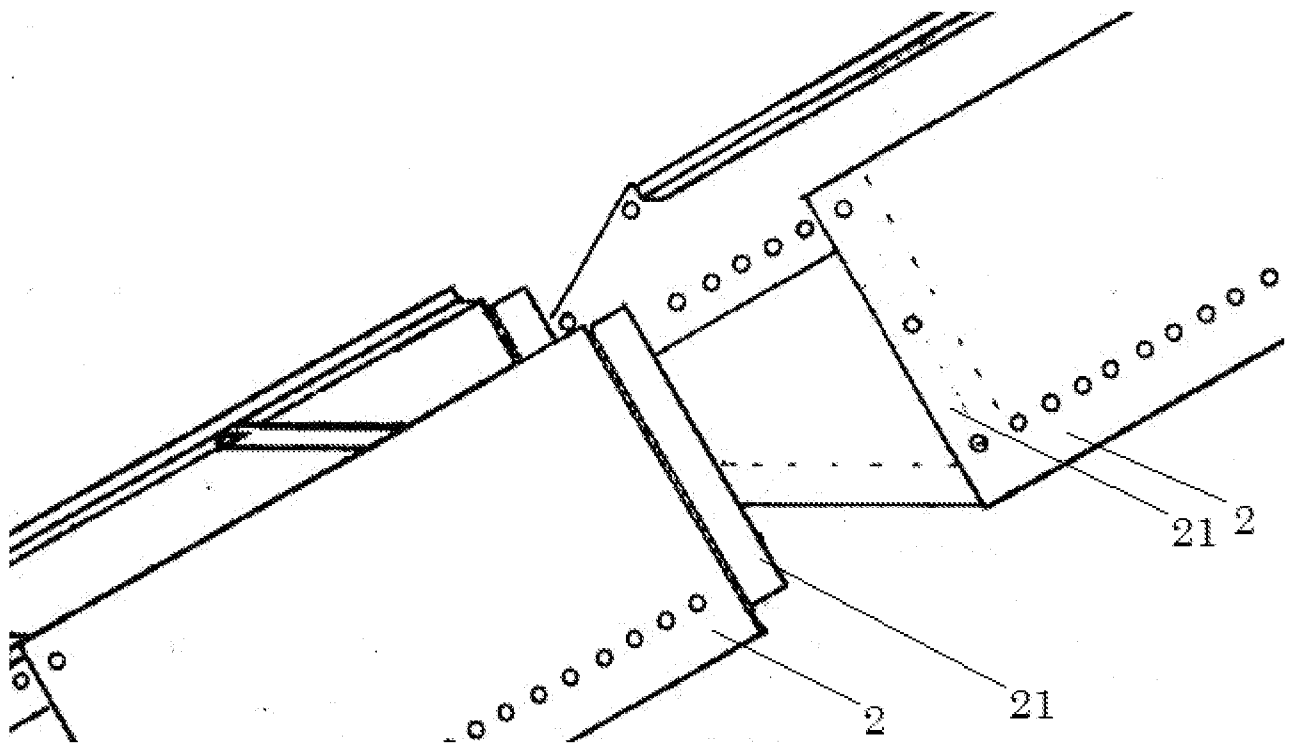


FIGURE 3

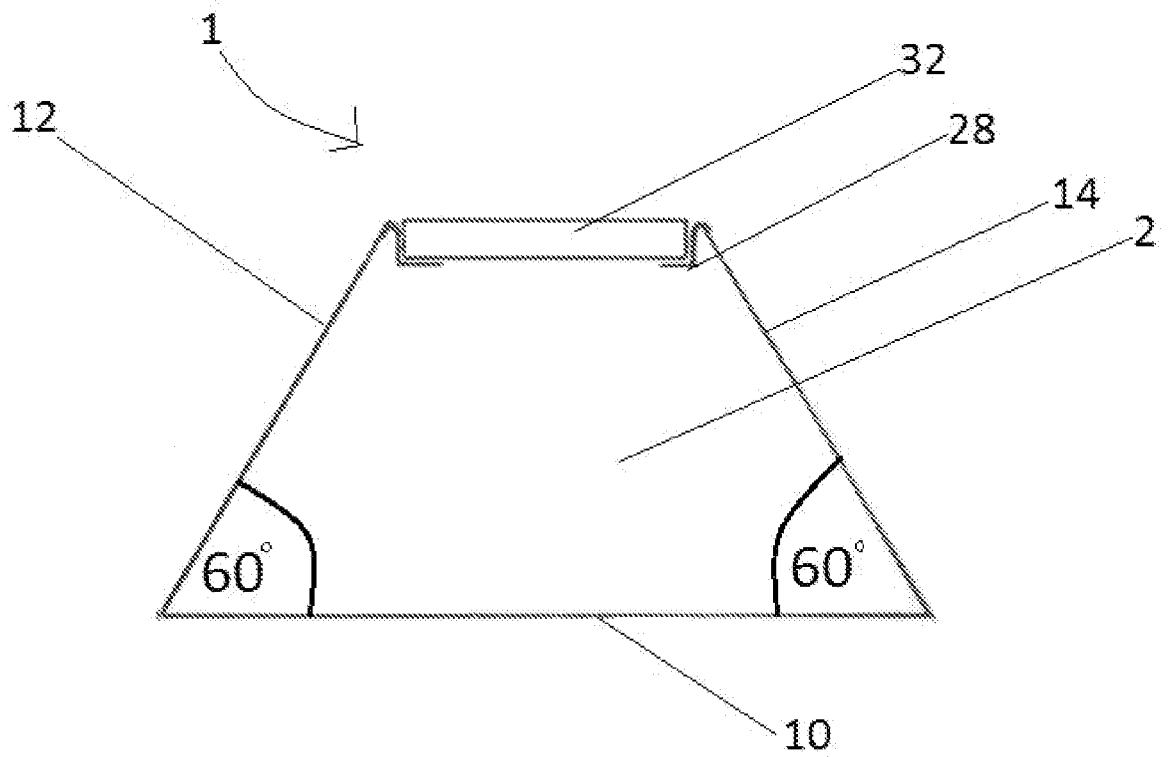


FIGURE 4

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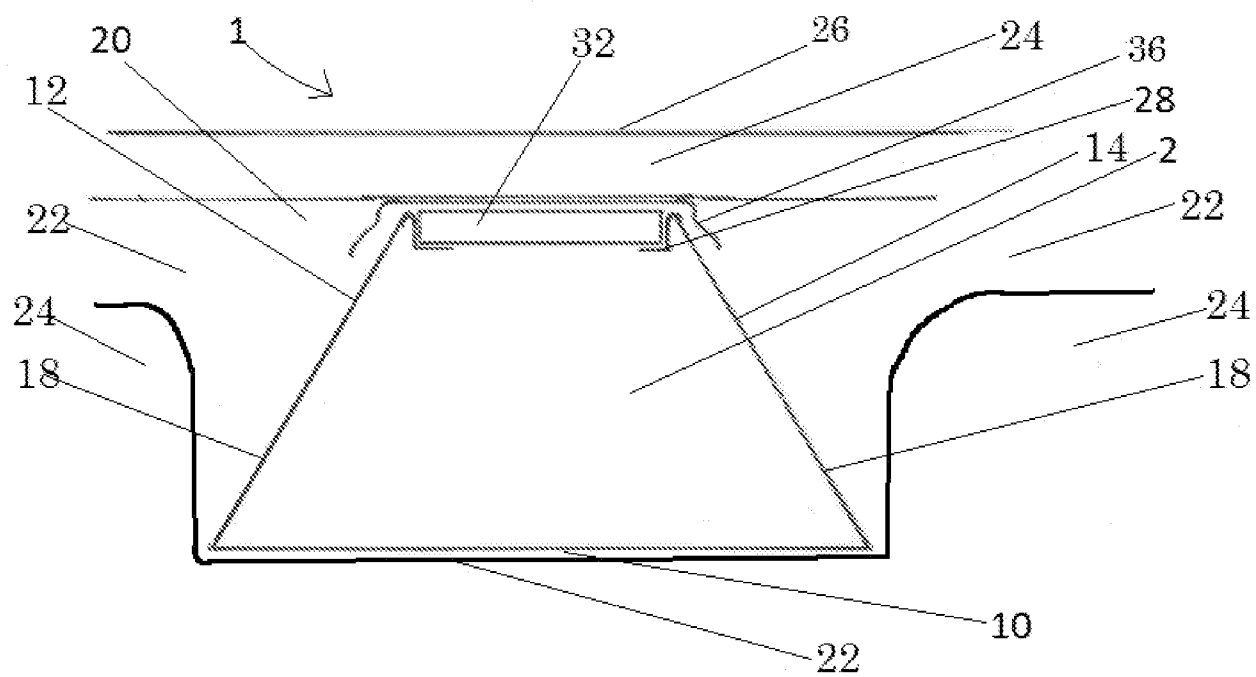


FIGURE 5



FIGURE 6

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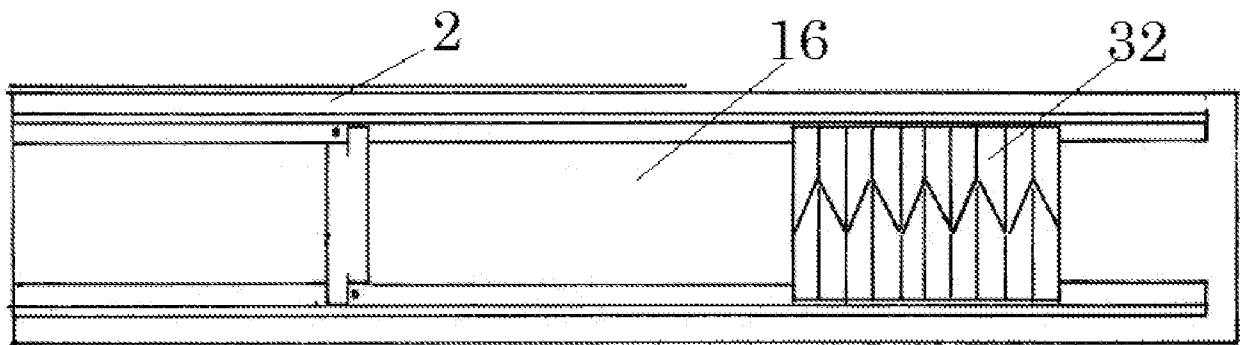


FIGURE 7

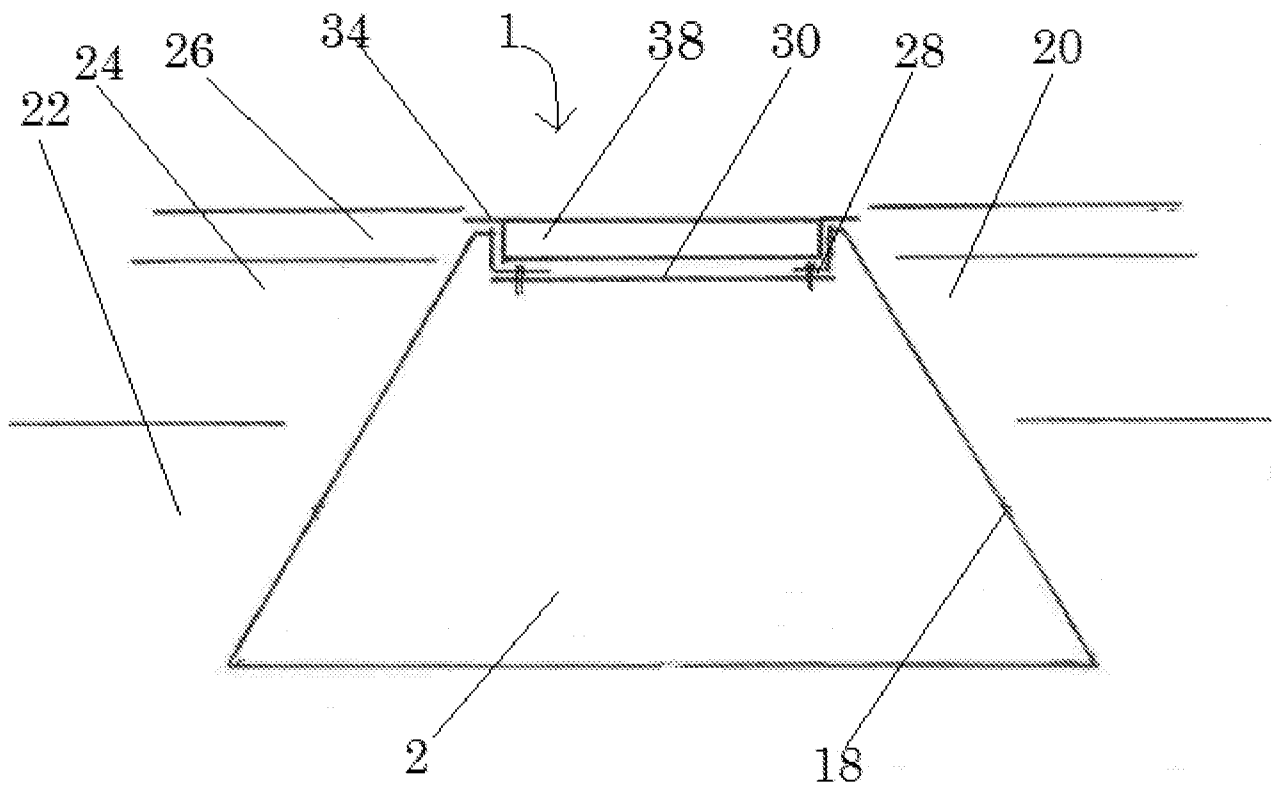


FIGURE 8

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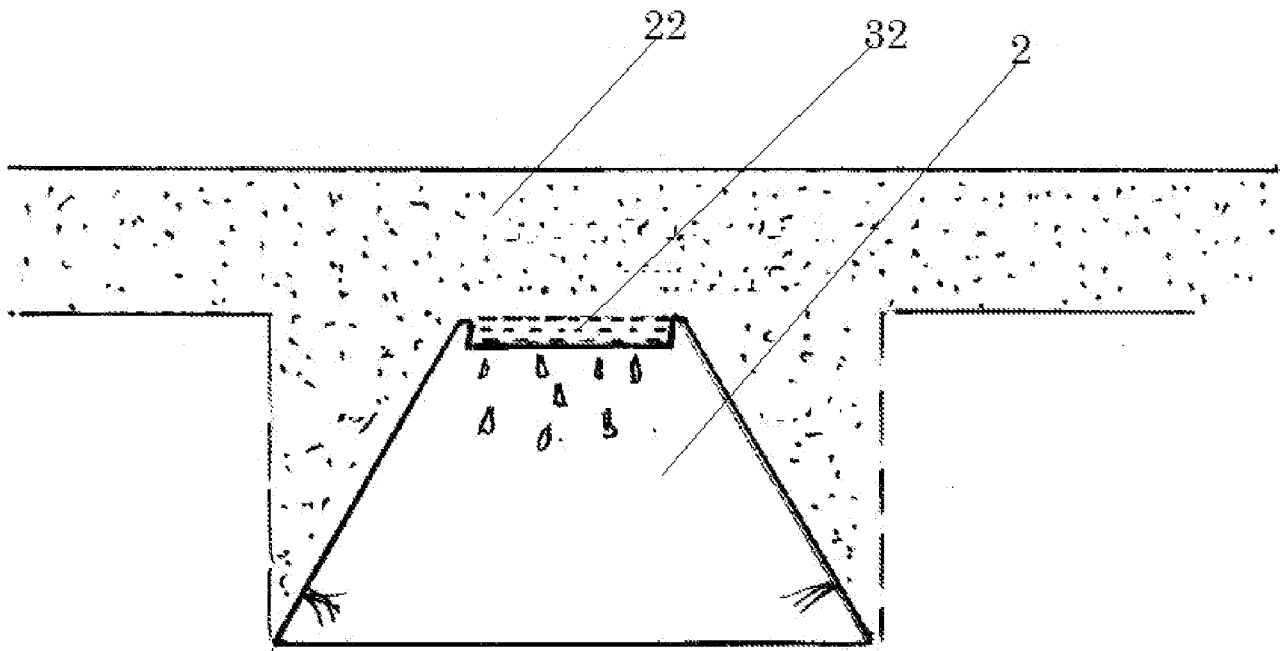


FIGURE 9

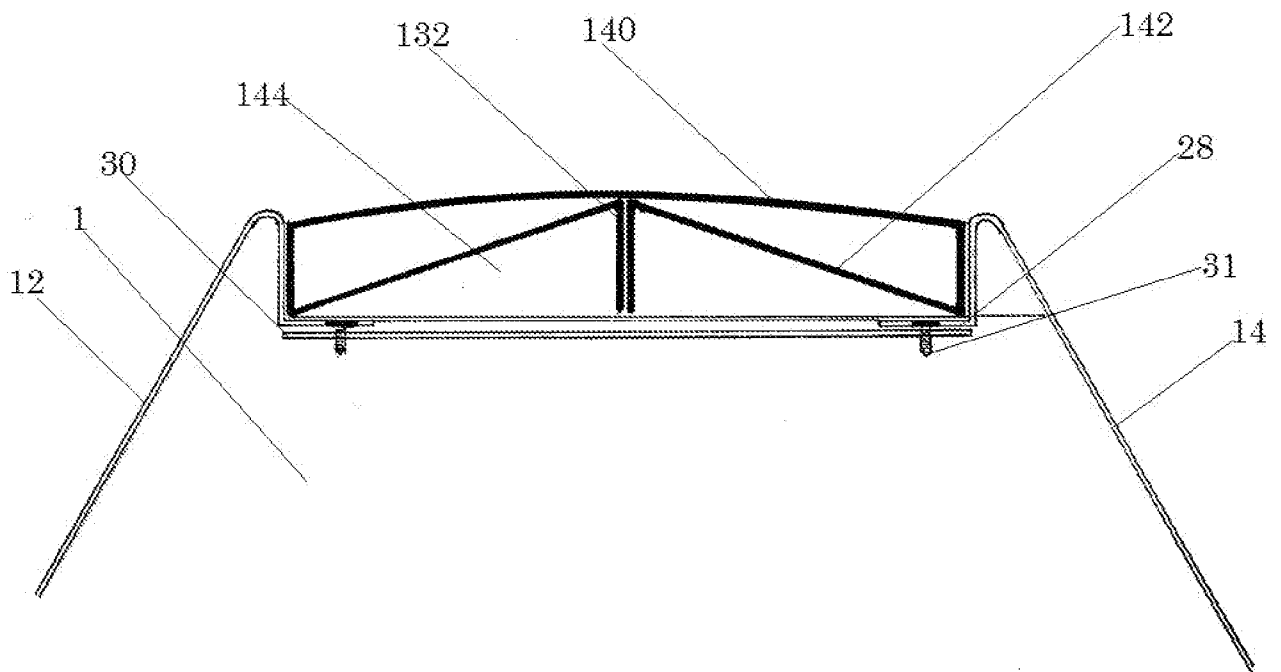


FIGURE 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2013/000221

A. CLASSIFICATION OF SUBJECT MATTER

E02B 11/00 (2006.01) E01C 13/02 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI - IPC, ECLA: E01B1, E01C3, E01C11/22/low, E01C13, E01F5, E02B11, E02D3/00, E02D3/10, E02D31/02/low, E03F1, E03F3, E03F5 and Keywords (drain, pipe, triangle, angle, acute, trapezoid, dove tail, quadrilateral, profile, mesh, lift, force, pressure, wide, flat, base, open, top, channel, gutter, ground, stadium, pitch, sport, grass, sand, golf, sub surface, buried) & like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
30 April 2013

Date of mailing of the international search report
30 April 2013

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INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2013/000221
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 1520942 A1 (ACO TECHNOLOGIES PLC) 06 April 2005 Abstract; figures 1-7; paragraphs 17, 32-34; claims 9-12 Abstract; figures 1-7	1-28, 33-39 1-39
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