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(54) **Title:** A STORM WATER FILTER SYSTEM, A COLLAPSIBLE FRAME, A DRAIN PIT AND ASSOCIATED METHODS

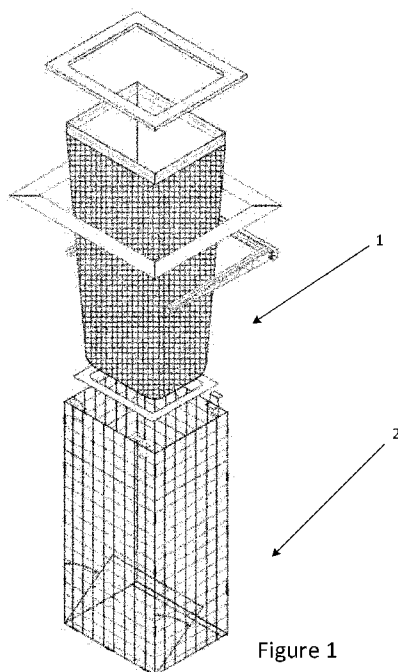


Figure 1

(57) **Abstract:** A storm water drain pit having a flow control system which, during periods of low flow, maintains the level of liquid in the pit below a first level and, during periods of high flow, maintains the level of liquid above a second level. A first collapsible frame has perforated panels connected together by hinge joints so that the panels may be folded into a flat pack configuration and unfolded to form a frame to surround and support a storm water drain bag. A tubular frame may be formed from by rolling up a perforated sheet into a cylinder of desired diameter, fitting bands to the top and bottom of the cylinder, fixing them to the cylinder and fitting a base. The bands may be flat strips having support brackets provided at intervals projecting away from a flat face of the strip to provide support for the rim of a filter bag. A storm water filter system includes a pit having an inlet and an outlet; a plurality of pit inserts in the form of perforated frames supporting filter bags; a flow distributor which distributes fluid from the inlet into all or selected ones of the plurality of pit inserts; and an outlet for receiving liquid passing through the pit inserts exiting from the pit.



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A STORM WATER FILTER SYSTEM, A COLLAPSIBLE FRAME, A DRAIN PIT AND ASSOCIATED METHODS

FIELD OF THE INVENTION

5 This invention relates to filtration apparatus for removing and recovering particulates and contaminants from storm water run-off. It also relates to methods of forming and installing storm water drain filters.

BACKGROUND OF THE INVENTION

10 Storm water (also known as stormwater) and contaminants (i.e. gross particulate matter, sediment, oil, grease, hydrocarbons, heavy metals etc,) enters storm water drains via 'pits' also know as catch basins and stormwater inlets. It is desirable to retain these contaminants at the point of entry to the stormwater piping system and to periodically remove them to avoid blockage and
15 contamination of the stormwater drainage system. Pit inserts including a supporting frame and filter bag are used to remove contaminants and these need to be periodically removed for emptying and replacement.

The primary objectives of stormwater filter systems are:

- 20
- to retain a large volume of contaminants, compared to the size and dimensions of a specific catchpit – high volume efficiency;
 - to maintain performance and throughput of the catchpit during periods of high flow;
 - to provide dimensional stability such that the filter does not bulge
25 beyond the dimensions of the inlet preventing removal;
 - to be able to be easily removed for maintenance by hand, without the requirement for mechanical lifting or induction by vacuum truck

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Recent filter systems that utilise a filtration mesh/fabric body can be broadly categorized into two types:

- Filters that are flexible and self-supporting
- Filters that are flexible and supported by an external rigid cage.

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Filters that are flexible and self-supporting tend to be of much smaller volume than the pits into which they are fitted, due to the fact that unsupported flexible materials cannot provide dimensional stability. This has a detrimental effect on the volume of material that can be retained in the filter and maintenance requirements.

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Filters that are supported by external rigid cages are provided with dimensional stability as the filter body cannot bulge or expand beyond the limits of the cage. They allow for a larger bag volume which allows smaller particles to be captured. However, these cages can add significantly to the mass of the filter apparatus and cannot be collapsed for transport or bespoke fitting to particular catchpits.

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Where a bag is supported by a rigid frame it is bulky to transport and handle, uses much material to achieve rigidity, and can be difficult to install since many pits have differences in geometry or manufacturing flaws sometimes requiring a custom fit. The designs may also suffer from bulging of the filter bag which can block a pit outlet and place localised stress on the filter bag. In addition, the bulging of the bag can cause it to be trapped in the frame or pit walls, to the extent it is not removable without considerable effort or damage to the bag or frame. The designs may also suffer from small filter area and containment volume requiring a high frequency of maintenance. The designs may also be complex, expensive to manufacture and pose a potential fire risk.

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When the filter is immersed in water, there is a possibility that the trapped material will contaminate the exiting water. The filter bag may become bio-fouled and it has also been found that this is a preferred habitat for mosquitos in tropical countries. It would be desirable for the filter bag to be above the water level in the pit during periods of low flow. It would also be desirable for the filter bag to be below the water level during periods of high flow to dissipate energy.

The applicant's prior application US20140374332 discloses frame and bag constructions for pit inserts as well as pit designs and the disclosure of this application is included by reference.

It is an object of the invention to provide an improved storm water filter system and components and methods of installation and use or to at least provide the public with a useful choice.

Reference to any prior art in this specification does not constitute an admission that such prior art forms part of the common general knowledge.

SUMMARY OF THE INVENTION

According to one exemplary embodiment there is provided a storm water drain pit including a flow control system which, during periods of low flow, maintains the level of liquid in the pit below a first level and, during periods of high flow, maintains the level of liquid above a second level at least 0.3m higher than the first level.

According to another exemplary embodiment there is provided a collapsible frame for supporting a storm water drain bag including a plurality of perforated rigid side panels and a base panel connected together by hinge joints along edges of the panels such that the panels may be folded into a substantially flat

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pack configuration and unfolded to form a frame that may surround and support a storm water drain bag.

5 According to a further exemplary embodiment there is provided a frame for supporting a storm water drain bag including a perforated sheet formed into a cylinder having bands at the top and bottom retaining the sheet in cylindrical form and a base provided at one end of the cylinder.

10 According to a further exemplary embodiment there is provided a band for forming a frame for a pit insert comprising a flat strip having support brackets provided at intervals wherein the brackets project away from a flat face of the strip so as to provide effective support for the rim of a filter bag when installed in a frame. A kit for forming a frame for a pit insert may be provided including such a band and a sheet of mesh and a bottom band.

15 There is further provided a method of forming a frame from a sheet of perforated material comprising rolling the perforated sheet into a cylinder of desired diameter, fitting bands to the top and bottom of the cylinder, fixing them to the cylinder and fitting a base.

20 According to another exemplary embodiment there is provided a storm water drain assembly including a storm water drain pit as hereinbefore described and a pit insert positioned within the pit such that during periods of low flow the bottom of the pit insert is maintained above the low flow fluid level in the pit and
25 during periods of high flow the bottom of the pit insert is at or below the high flow fluid level in the pit. The pit insert may be of the form hereinbefore described.

According to another exemplary embodiment there is provided a storm water drain frame having a base and side walls and a flotation layer positioned in the base of the frame to support a filter bag at or above liquid when in use.

- 5 According to a still further exemplary embodiment there is provided a storm water filter system comprising:
- a. a pit having an inlet and an outlet;
 - b. a plurality of pit inserts in the form of perforated frames supporting filter bags;
 - 10 c. a flow distributor which distributes fluid from the inlet into all or selected ones of the plurality of pit inserts; and
 - d. an outlet for receiving liquid passing through the pit inserts exiting from the pit.

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BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings which are incorporated in and constitute part of the specification, illustrate embodiments of the invention and, together with the general description of the invention given above, and the detailed description of
20 embodiments given below, serve to explain the principles of the invention.

- Figure 1** shows an exploded perspective view of a storm water drain filter system;
- Figure 2** shows a collapsible frame according to a first embodiment;
- 25 **Figure 3** shows a collapsible frame according to a second embodiment;
- Figure 4** shows the collapsible cage of Figure 3 in a different configuration;

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- Figure 5** shows a collapsible frame of the same type as shown in Figures 3 and 4 but of different dimensions;
- Figure 6** shows the collapsible cage of Figure 3 in a different configuration;
- Figure 7** shows a collapsible frame of the same type as shown in Figures 3
- 5 **Figure 8** shows a bracket for mounting a frame to a pit;
- Figure 9** shows an exploded view of an arrangement for mounting a frame to a pit;
- Figure 10** shows a collapsible frame of generally cylindrical form;
- Figure 11** shows a band provided around the opening of the collapsible
10 frame shown in Figure 10;
- Figures 12 and 13** show a method of forming a collapsible frame;
- Figure 14** shows a bottom perspective view of a frame having a base formed of cables;
- Figure 15** shows a side cross-sectional view of a frame and filter bag
15 installed in a pit employing a syphon flow control system;
- Figure 16** shows a side cross-sectional view of a frame and filter bag installed in a pit employing a flow control system employing restricted and unrestricted outlets;
- Figure 17** shows a flow control system in the form of a syphon box;
- 20 **Figure 18** shows a plan view of storm water filter system including a plurality of pit inserts;

Figure 19 shows a side cross sectional view of the storm water filter system shown in Figure 18;

Figure 20 shows a perspective view of the storm water filter system shown in Figure 18; and

5 **Figure 21** shows a plan view of a dissipation layer.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Figure 1 shows an exploded view of a pit insert consisting of a filter bag 1 that locates within a collapsible frame 2.

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Figure 2 shows a collapsible frame according to a first embodiment consisting of perforated rigid side panels 3 to 6 (shown in wire outline only to assist comprehension) interconnected along their side edges by hinged connections 7 (only one of which is indicated). A base 8 also formed of a perforated rigid panel is hingedly connected along one edge to the lower edge of panel 6. The panel may be manipulated from a flat pack state in which panels 4 and 6 are brought together and an open configuration in which the frame has a generally open box form. When the sides are brought into the open box form base 8 may be rotated from a position in which it is against panel 6 to a position in which the free edge of base 8 rests on ledge 9. Figure 1 shows all panels of the frame formed of wire mesh with the base in the almost completely lowered position.

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This construction allows the frame to be transported in a compact flat form and then easily inserted into a pit and opened for use. It may then be installed in a pit and a filter bag inserted.

Figure 3 shows a modified form of the frame shown in figure 2 in which two of the sides have a bifolding construction. The frame consists of side walls 11 to 16

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having hinged joints 17 (only one of which is indicated). In this case the end walls are formed of bifolding panel pairs 13 and 14; and 15 and 16. To put the frame in its flat configuration base 18 is rotated up against panel 12 and bifolding panel pairs 13 and 14; and 15 and 16 are forced inwardly at their hinges as shown part way through folding (it is to be noted that base 18 would be against panel 12 when the bifolding panels are moved inwards). To open the frame the hinges between the bifolding panels are moved outwards to the position shown in Figure 4 and the base 18 is rotated down so that its distal edge rests upon ledge 19.

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This construction has the advantage that it has a more compact form that will reduce size for transport and assist inserting the frame into a pit.

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In the above embodiments the side panels and base may all be formed of a perforated material such as a mesh. This is preferably a plastics coated metal mesh such as a fuse bonded PVC coated galvanised metal mesh sold under the trade mark AQUAMESH™. This material is relatively inert and durable so that when submerged or partially submerged it has reduced leaching of harmful pollutants such as zinc compared to typical galvanized wire.

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The hinge joints 7 and 17 may be crimped metal clips as shown in Figures 6 and 7. Figure 6 shows a 'J' clip about wires 20 and 21 (sections of panels of the frames) and Figure 7 shows the 'J' clip 22 when closed around wires 20 and 21. It will be appreciated that other suitable fasteners such as ratchet clips may also be employed.

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Figure 8 shows a bracket 30 for mounting a frame to a pit. The bracket 30 may be secured to the mesh 31 of a side of a frame by suitable fasteners or welding etc. a first extension 33 is provided to support the rim of a filter bag provided

within a frame. A series of extensions 33 around the opening of the frame support a wire rim around the opening of the filter bag. A second extension 32 is used to secure the bracket to the pit or a structure at the pit opening. Fasteners 34 may be used to secure the bracket directly to the pit. Alternatively, extension 32 may rest on the edges of an opening in the pit – either the pit side walls or a plate etc. provided at the pit opening. Figure 9 shows such an arrangement where a pit 40 has a metal sheet 41 with an opening dimensioned to receive a frame 43. A series of brackets around the mouth of frame 43 have extensions 42 that allow the frame to hang from plate 41. A grill 44 may be placed over the assembly.

Referring now to Figures 10 and 11 a generally cylindrical collapsible frame 50 is formed from a sheet of perforated material 51, such as the mesh described in relation to the previous embodiment. A filter bag 52 is located within the frame 50 as indicated by 52 in the cutaway section. A bottom band 58 is in the form of a flat strip of metal with apertures 59 provided at intervals at either end. The band is initially a flat strip and the ends are brought together to form a band and a fastener 60 secures the band at a required size. A top band 53 is provided around the top of the mesh cylinder 51 and secured thereto by suitable fasteners. As shown in Figure 11 the top band 53 is in the form of a flat strip of metal having apertures 56 at intervals at either end or along its entire length. Brackets 54 are provided at intervals and have inward ledges 55 for supporting the rim of a filter bag.

Referring now to Figures 12 and 13 a frame is formed by rolling a sheet of mesh 51 into a cylinder as shown in Figure 12 and marking a cutting point at a desired radius. The excess mesh is then cut along cut line 61 as shown in Figure 13. A top band 53 is formed from a continuous strip (either using the whole strip or cutting a length) of material and the ends are fastened together by a fastener 57

through aligned apertures 56. Likewise, a continuous strip is used to form the bottom band (either using a whole strip or cutting a section from a longer strip) and at a required radius a fastener 60 passes through aligned apertures 59 to form a band of the required radius. The top and bottom bands are then secured to the mesh cylinder using suitable fasteners. The base of the frame may be either a preformed circular base of requisite size or else cable sections 62 may be threaded between lower openings in the mesh to form a base as shown in Figure 14.

This construction allows frames of the required diameter to be formed on site as well as providing a very compact form for transport. The bands may be adjustable over a wide range of frame diameters and may be cut from a roll to accommodate a wide range of sizes.

Referring now to Figure 15 a storm water drain pit 70 with a pit insert 71 is shown. The pit includes a flow control system which, during periods of low flow, maintains the level of liquid in the pit below a first "low" level 75 below the bottom of filter bag 73 and, during periods of high flow, maintains the level of liquid above a second "high" level 74, at or above the bottom of filter bag 73. The second level is preferably at least 0.3m, and more preferably 0.5 m, higher than the first level. In this case a syphon 72 provides the flow control as when the water level is at the high level 74 it will continue to flow out of the syphon 72 until the level drops to the level of the syphon inlet 76. During periods of high flow, the water level will rise until it reaches high level 74 and the syphon is re-established. This arrangement ensures that during periods of high flow the higher water level helps dissipate energy in the flow and during periods of low flow pollutants in filter bag are kept dry and out of the standing water and so leaching is reduced whilst also allowing the sump to drain down to minimise the volume of standing water in the pit.

Whereas the embodiment shown in Figure 15 is implemented using a syphon pipe a box syphon may be advantageous for certain applications. Figure 17 shows a box syphon formed integrally as part of a pit with wall 81 being the
5 outer wall of the pit, with the syphon being formed by outer walls 82 and 83 and inner wall 84.

Figure 16 shows a flow control system using restricted and unrestricted outlets. Pit 90 has an unrestricted upper outlet to ensure that water at a high level 92 is
10 removed from the pit and a lower restricted outlet 93 which only allows a reduced flow until water reaches a lower level 95. The reduced flow may be achieved by placing a restrictor 94 of reduced area in outlet 93. Whilst the level of restriction will depend upon the application outlet 93 may typically only allow
15 10% or less of the flow rate allowed through outlet 91. Again whilst the level of restriction will depend upon the application outlet 93 may typically only allow a flow rate of 1 litre per second or less.

Two further features may be provided to enhance performance. A flotation layer 96 may be provided under filter bag 97 within frame 98. The flotation layer 96
20 may be a block of closed cell foam or a moulded hollow structure etc. This may assist in keeping the filter bag above the water level and assist in dissipating energy from the water flow.

Additionally, or alternately, layer 97 may be an energy dissipation layer to
25 dissipate energy. As shown in Figure 21 the dissipation layer may be in the form of a lattice defining a plurality of through holes. This layer may be formed of a buoyant plastics material or may be formed with a hollow core so that it may remain buoyant. This layer helps to further dissipate energy of the flow so as to reduce the amount of suspended material in the flow exiting the pit.

Referring now to Figures 18 to 20 a storm water filter system 100 is shown in which pit 101 has an inlet 102 which supplies the inlet flow to a flow distributor in the form of channel 103. Channel 103 in this embodiment has V shaped outlets (one of which is indicated at 105) to supply flow to a plurality of pit inserts 104. A V shaper outlet is effective to equalize flow between filter inserts. The profile of the outlets may be modified to achieve a desired distribution. Alternatively, each outlet 105 may be a flume or a flume with internal baffles or another hydraulic primary structure to evenly load the individual pit inserts. One or more outlet 105 may be closed by placing a sheet of material across it to allow a pit insert to be removed for replacement or maintenance when grate 107 is removed. This allows the system to operate continuously during maintenance. Fluid passing through filter inserts 104 flows into the base of the pit 101 and exits via a box syphon 106 as described in relation to previous embodiments.

This arrangement allows a high throughput whilst each pit insert 104 may be of a size that is easily handled for maintenance and replacement. The system is also easily scaled and provides the other advantages of the previous embodiments.

distributor is a channel with openings adjacent the tops of the pit inserts.

There is thus provided a filter system and components that are simple, reliable, light weight, inexpensive to manufacture, compact for transportation, retain their shape well, maximize filter area and storage volume and is easy to install and maintain.

While the present invention has been illustrated by the description of the embodiments thereof, and while the embodiments have been described in detail, it is not the intention of the Applicant to restrict or in any way limit the

scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative apparatus and method, and illustrative examples shown and described. Accordingly, departures may be made from such details without
5 departure from the spirit or scope of the Applicant's general inventive concept.

CLAIMS:

1. A storm water drain pit including a flow control system which, during periods of low flow, maintains the level of liquid in the pit below a first level and, during periods of high flow, maintains the level of liquid above a second level at least 0.3m higher than the first level.
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2. A storm water drain pit as claimed in claim 1 wherein the flow control system maintains the level of liquid above a second level at least 0.5m higher than the first level.
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3. A storm water drain pit as claimed in claim 1 or claim 2 wherein the flow control system is in the form of a syphon from the pit to a storm water drain.
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4. A storm water drain pit as claimed in claim 3 wherein the flow control system is in the form of a syphon box.
5. A storm water drain pit as claimed in claim 1 wherein the flow control system includes a lower outlet positioned towards the base of the pit and an upper outlet positioned above the lower outlet, wherein the lower outlet allows a lower flow rate out of the pit than the upper outlet.
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6. A storm water drain pit as claimed in claim 5 wherein the lower outlet includes a flow restrictor.
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7. A storm water drain pit as claimed in claim 6 wherein the lower outlet provides a flow rate that is less than 10% of the flow rate allowed by the upper outlet.
- 5 8. A storm water drain pit as claimed in claim 6 wherein the lower outlet provides a flow rate that is less than 1 litre/second.
9. A storm water drain pit as claimed in any one of claims 6 to 8 wherein the lower outlet includes a flow restrictor.
- 10 10. A storm water drain pit as claimed in any one of the preceding claims including a plate across the pit opening with an opening dimensioned to receive a pit insert.
- 15 11. A collapsible frame for supporting a storm water drain bag including a plurality of perforated rigid side panels and a base panel connected together by hinge joints along edges of the panels such that the panels may be folded into a substantially flat pack configuration and unfolded to form a frame that may surround and support a storm
20 water drain bag.
12. A collapsible frame as claimed in claim 11 which when in its unfolded state has a generally open box form.
- 25 13. A collapsible frame as claimed in claim 11 or claim 12 wherein a pair of opposing side panels are each formed of hinged sub-panels which may concertina inwardly to facilitate folding into a flat configuration.

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14. A collapsible frame as claimed in any one of claims 11 to 13 wherein one edge of the base panel has a hinged connection to a side panel allowing it to rotate about that side panel to facilitate folding into a flat configuration.
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15. A collapsible frame as claimed in 14 wherein the side panel opposing the side panel that is hingedly connected to the base panel, has a return ledge to support the distal edge of the base panel.
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16. A collapsible frame as claimed in any one of claims 11 to 15 wherein the perforated rigid side panels and base panel are formed of mesh.
17. A collapsible frame as claimed in claim 16 wherein the mesh is plastics coated metal mesh.
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18. A collapsible frame as claimed in claim 16 wherein the mesh is a fuse bonded PVC coated galvanised metal mesh.
19. A collapsible frame as claimed in any one of claims 11 to 18 wherein the hinge joints are in the form of crimped metal clips.
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20. A collapsible frame as claimed in claim 19 wherein the crimped metal clips are aluminium 'J' clips.
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21. A collapsible frame as claimed in any one of claims 11 to 18 wherein the hinge joints are in the form of or plastic ratchet clips.
22. A collapsible frame as claimed in any one of claims 11 to 21 including a flotation layer in the base of the frame.

23. A collapsible frame as claimed in any one of claims 11 to 22 including an energy dissipation layer in the base of the frame.
- 5 24. A collapsible frame as claimed in claim 23 wherein the energy dissipation layer is in the form of a lattice.
25. A collapsible frame as claimed in claim 24 wherein the energy dissipation layer is formed of plastics.
- 10 26. A collapsible frame as claimed in any one of claims 23 to 25 wherein the energy dissipation layer has positive buoyancy in water.
- 15 27. A collapsible frame as claimed in any one of claims 11 to 26 including a plurality of brackets secured to top edges of the collapsible frame having outwardly extending extensions adapted to hang the collapsible frame from the edges of a pit opening.
- 20 28. A collapsible frame as claimed in claim 27 wherein the brackets include inwardly directed extensions for supporting a ring of a filter bag.
- 25 29. A collapsible frame as claimed in claim 28 wherein the outwardly extending extensions are provided above the inwardly directed extensions.
30. A frame for supporting a storm water drain bag including a perforated sheet formed into a cylinder having bands at the top and bottom

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retaining the sheet in cylindrical form and a base provided at one end of the cylinder.

- 5 31. A frame as claimed in claim 30 wherein the perforated sheet is a plastics coated mesh sheet.
32. A frame as claimed in claim 31 wherein the mesh is a fuse bonded PVC coated galvanised metal mesh.
- 10 33. A frame as claimed in any one of claims 30 to 32 wherein the base is formed of mesh.
- 15 34. A frame as claimed in any one of claims 30 to 32 wherein the base is formed of a plurality of cable sections extending across the base of the cylinder.
35. A frame as claimed in any one of claims 30 to 34 wherein the bands are preformed annular bands of a desired diameter.
- 20 36. A frame as claimed in any one of claims 30 to 34 wherein the bands are variable diameter bands.
- 25 37. A frame as claimed in claim 36 wherein a plurality of apertures are provided along the bands enabling a fastener to be secured through selected apertures to set the band diameter.
38. A frame as claimed in any one of claims 30 to 37 wherein the band provided at the top of the frame has a full or partial lip to support a storm water drain bag.

39. A frame as claimed in any one of claims 30 to 38 including flotation layers in the base of the frame.
- 5 40. A frame as claimed in any one of claims 30 to 39 including an energy dissipation layer in the base of the frame.
41. A frame as claimed in claim 40 wherein the energy dissipation layer is in the form of a lattice.
- 10 42. A frame as claimed in claim 41 wherein the energy dissipation layer is formed of plastics.
43. A frame as claimed in any one of claims 40 to 42 wherein the energy dissipation layer has positive buoyancy in water.
- 15 44. A storm water drain assembly including a storm water drain pit as claimed in any one of claims 1 to 9 and a pit insert positioned within the pit such that during periods of low flow the bottom of the pit insert is maintained above the low flow fluid level in the pit and during periods of high flow the bottom of the pit insert is at or below the high flow fluid level in the pit.
- 20 45. A storm water drain assembly as claimed in claim 44 wherein the pit insert includes a frame as claimed in any one of claims 11 to 29.
- 25 46. A storm water drain assembly as claimed in claim 44 wherein the pit insert includes a frame as claimed in any one of claims 30 to 43.

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47. A method of forming a frame from a sheet of perforated material comprising rolling the perforated sheet into a cylinder of desired diameter, fitting bands to the top and bottom of the cylinder, fixing them to the cylinder and fitting a base.
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48. A method as claimed in claim 47 wherein a plurality of apertures are provided along the bands and a pair of apertures are aligned and a fastener is secured through the selected apertures to set the diameter of each band.
- 15
49. A method as claimed in claim 47 or 48 wherein the base is a mesh base.
50. A method as claimed in claim 47 or 48 wherein the base is formed by a series of lengths of cable passing between bottom edges of the perforated sheet.
- 20
51. A method as claimed in any one of claims 47 to 50 wherein the perforated sheet is a plastics coated metal mesh.
- 25
52. A method as claimed in claim 51 wherein the plastics coated metal mesh is a fuse bonded PVC coated galvanised metal
53. A storm water drain frame having a base and side walls and a flotation layer positioned in the base of the frame to support a filter bag at or above liquid when in use.
54. A storm water filter system comprising:
- a. a pit having an inlet and an outlet;

- b. a plurality of pit inserts in the form of perforated frames supporting filter bags;
- c. a flow distributor which distributes fluid from the inlet into all or selected ones of the plurality of pit inserts; and
- 5 d. an outlet for receiving liquid passing through the pit inserts exiting from the pit.
55. A storm water filter system as claimed in claim 54 wherein the distributor is a channel with openings adjacent the tops of the pit inserts.
- 10 56. A storm water filter system as claimed in claim 55 wherein the openings are V shaped openings to equalise flow to the pit inserts.
- 15 57. A storm water filter system as claimed in claim 55 wherein the openings are rectangular openings to equalise flow to the pit inserts.
58. A storm water filter system as claimed in any one of claims 55 to 57 wherein the openings may be selectively opened or closed.
- 20 59. A storm water filter system as claimed in any one of claims 55 to 58 including a flow control system that maintains the level of liquid above a second level at least 0.5m higher than the first level.
- 25 60. A storm water filter system as claimed in claim 59 wherein the flow control system is in the form of a syphon from the pit to a storm water drain.

61. A storm water filter system as claimed in claim 59 wherein the flow control system in the form of a syphon box.
- 5 62. A storm water filter system as claimed in any one of claims 54 to 61 including a collapsible frame as claimed in any one of claims 11 to 29.
63. A storm water filter system as claimed in any one of claims 54 to 61 including a collapsible frame as claimed in any one of claims 30 to 46.
- 10 64. A band for forming a frame for a pit insert comprising a flat strip having support brackets provided at intervals wherein the brackets project away from a flat face of the strip so as to provide effective support for the rim of a filter bag when installed in a frame.
- 15 65. A band as claimed in claim 64 wherein a plurality of apertures are provided at either end of the strip.
66. A band as claimed in claim 64 wherein apertures are provided along the length of the strip.
- 20 67. A kit for form a frame for a pit insert comprising a sheet of mesh, a top band as claimed in any one of claims 64 to 66 and a bottom band.
- 25 68. A kit as claimed in claim 67 wherein the bottom band is a flat strip having a plurality of apertures at either end.

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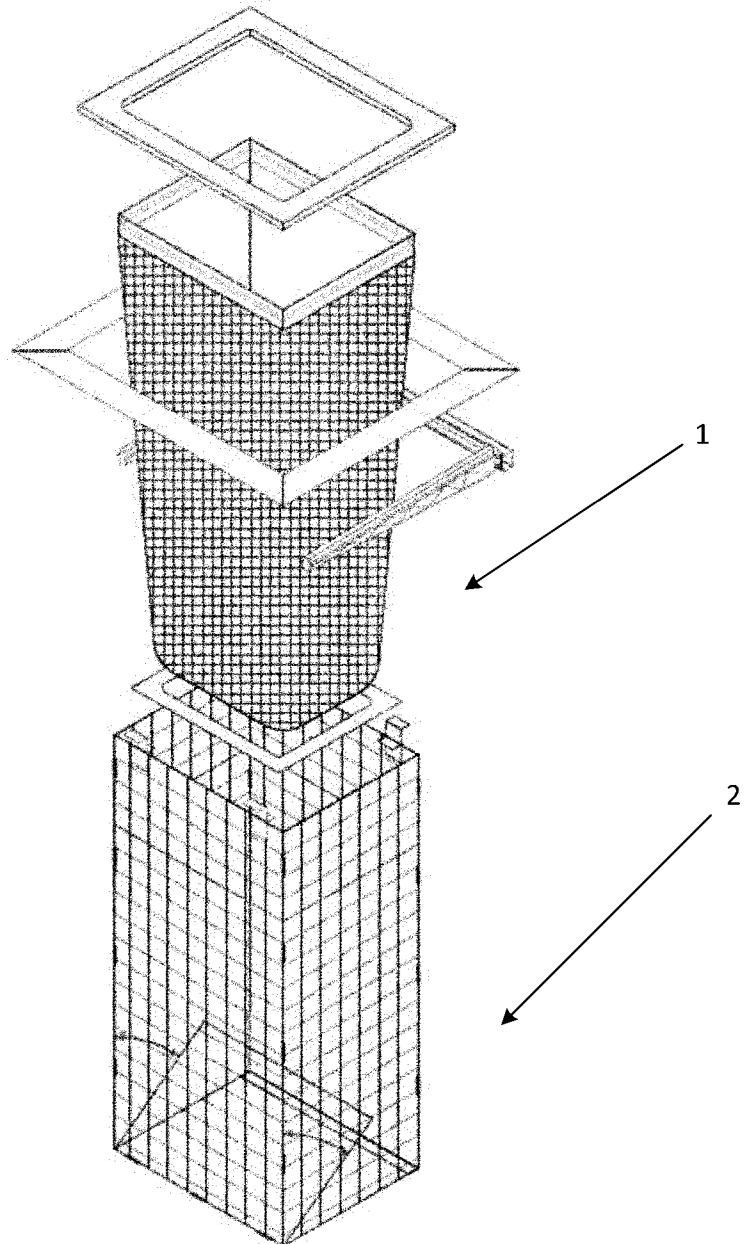


Figure 1

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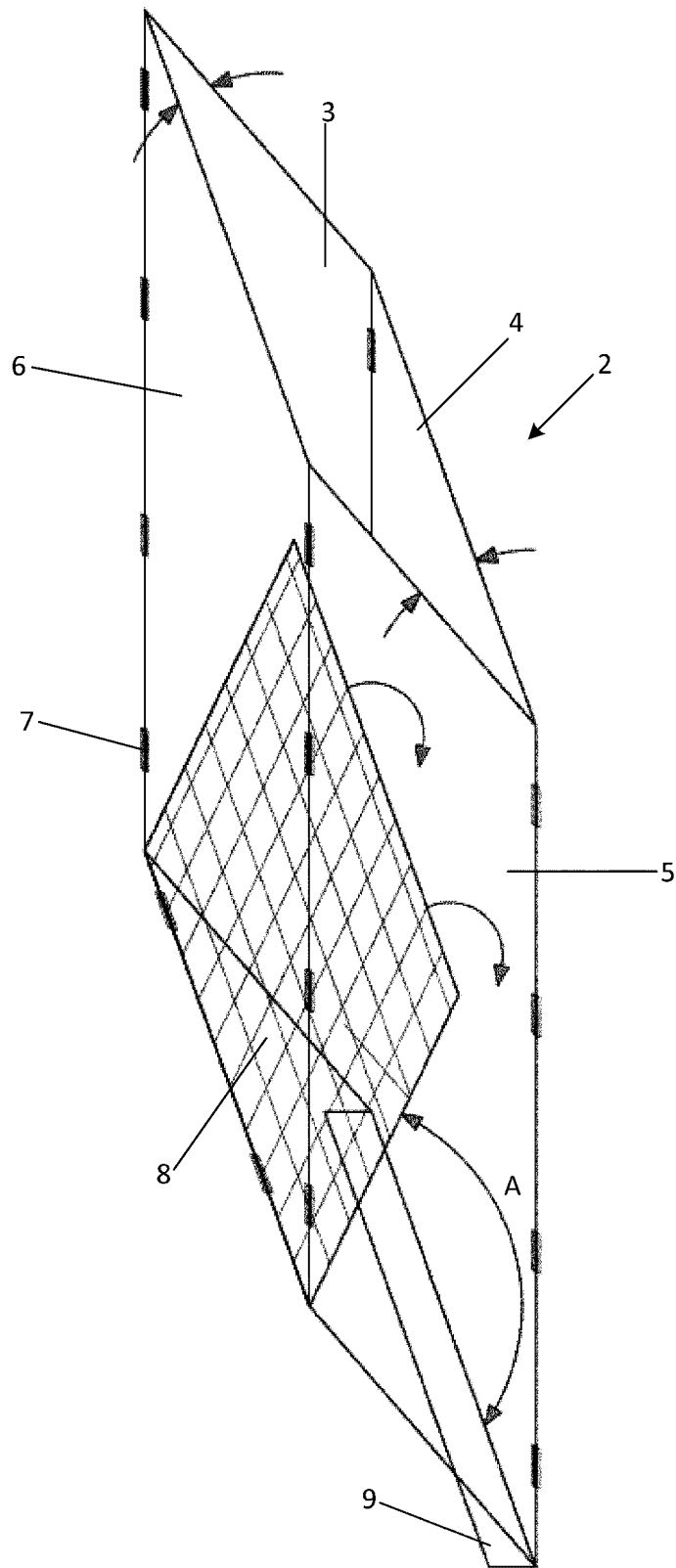


Figure 2

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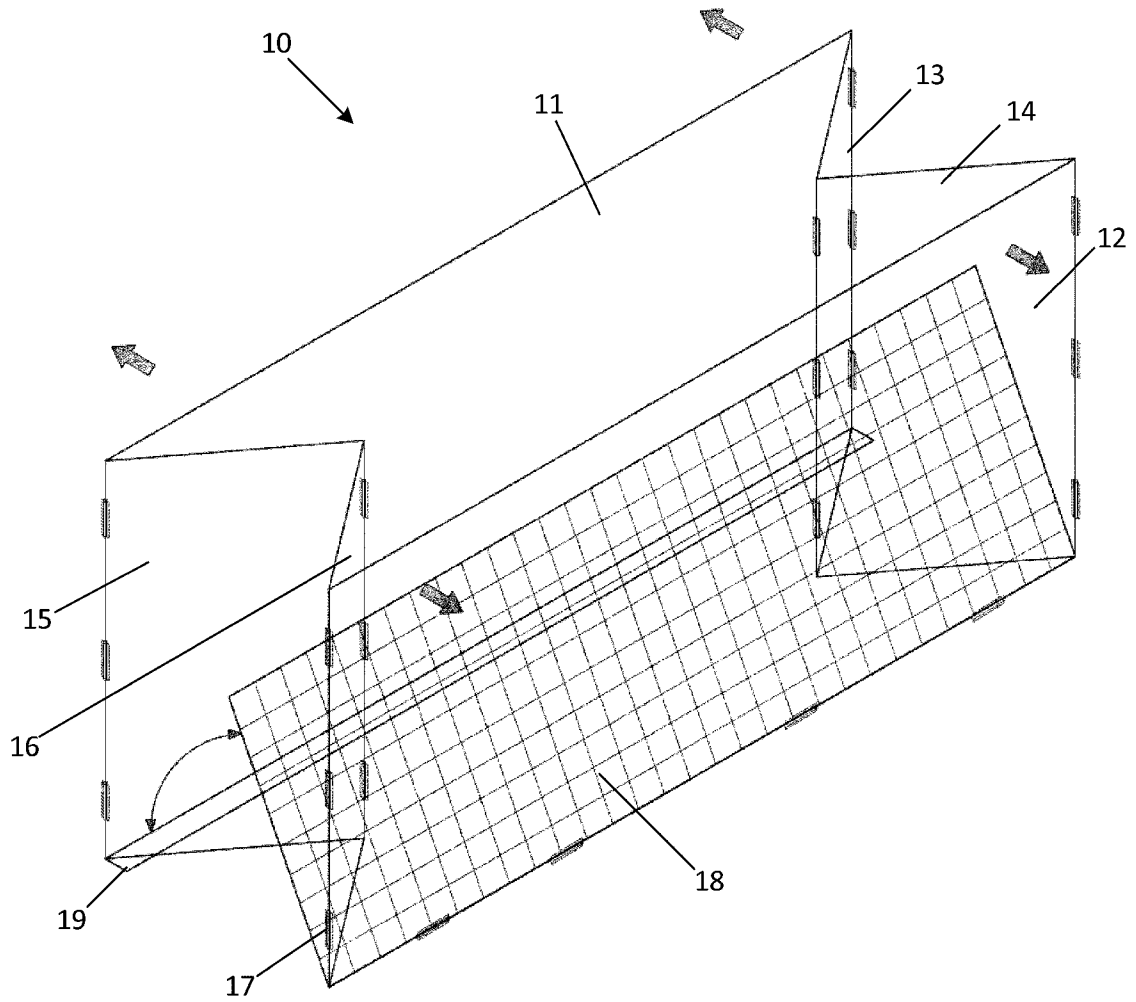


Figure 3

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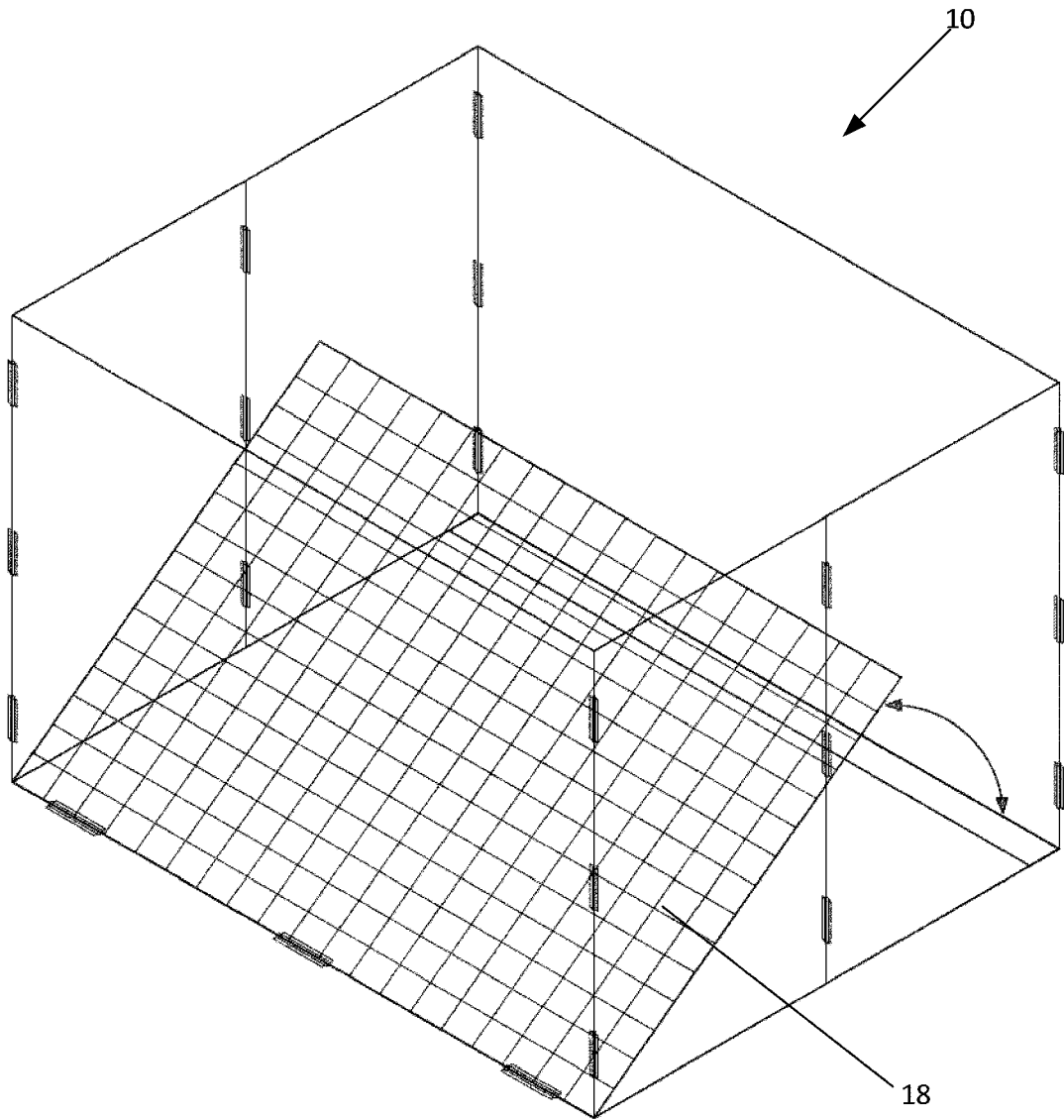


Figure 4

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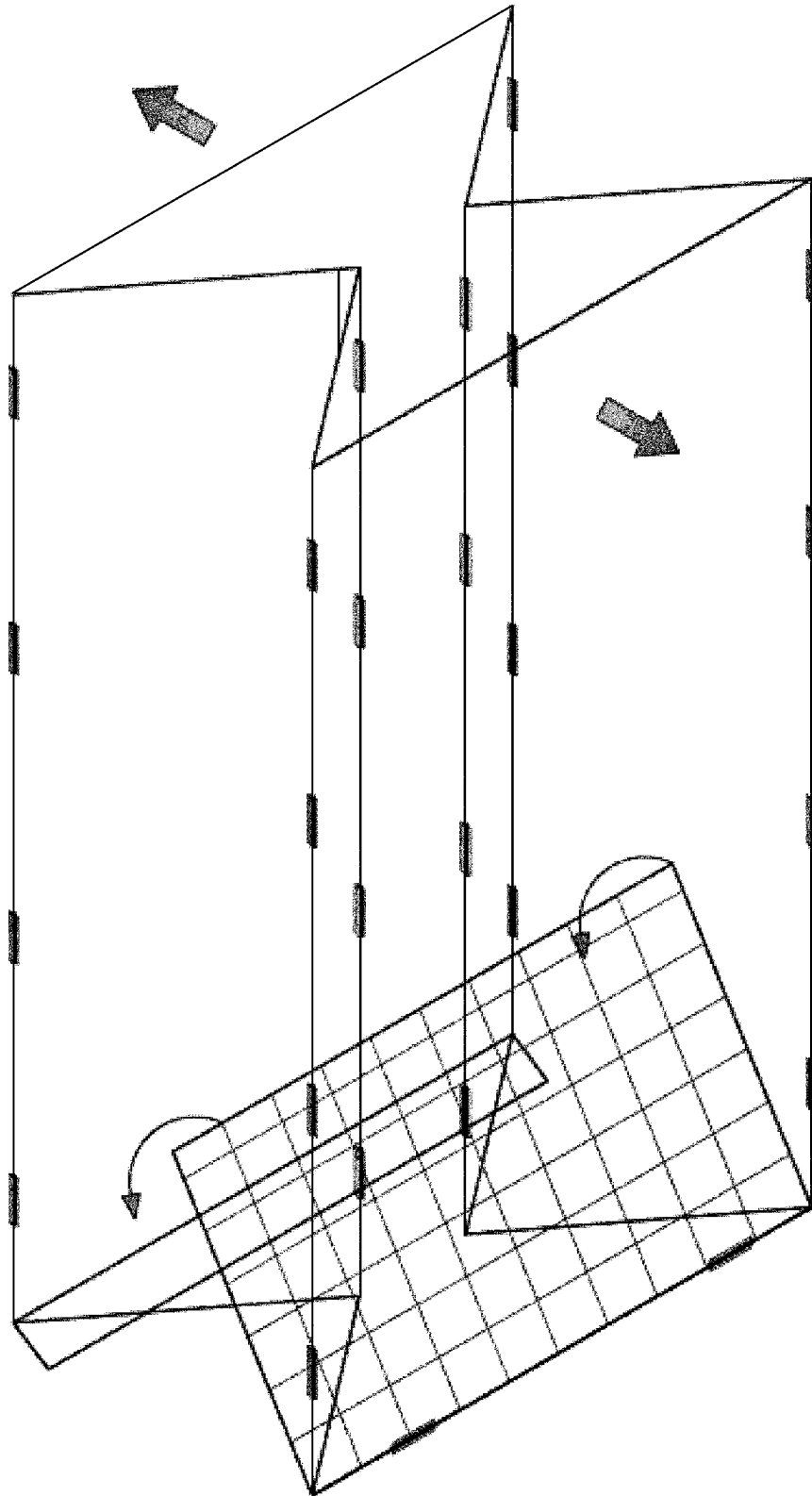


Figure 5

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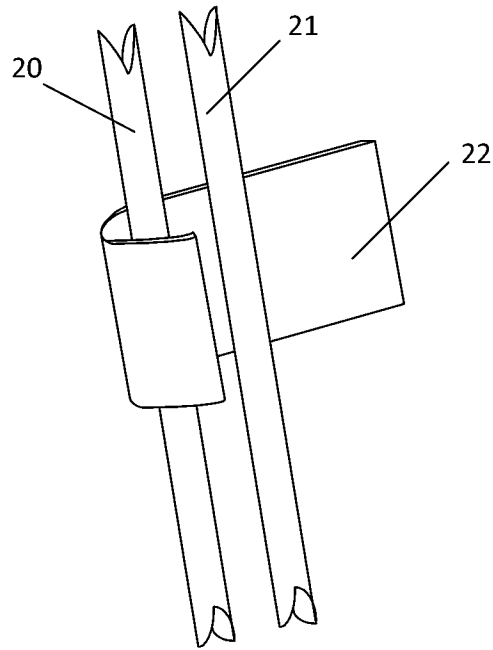


Figure 6

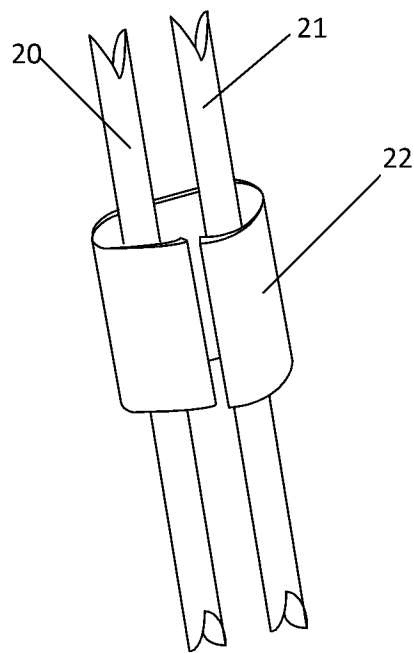


Figure 7

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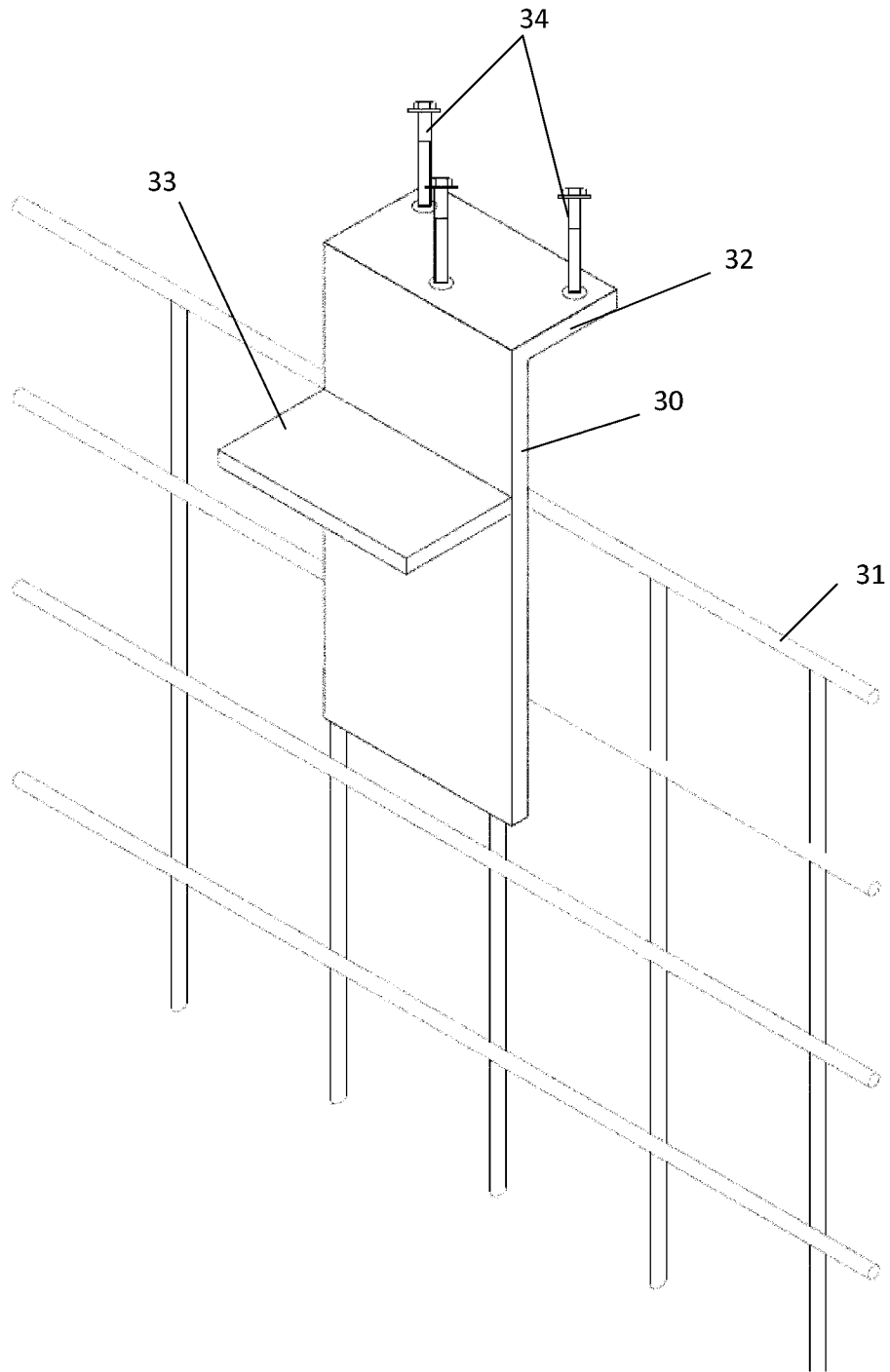


Figure 8

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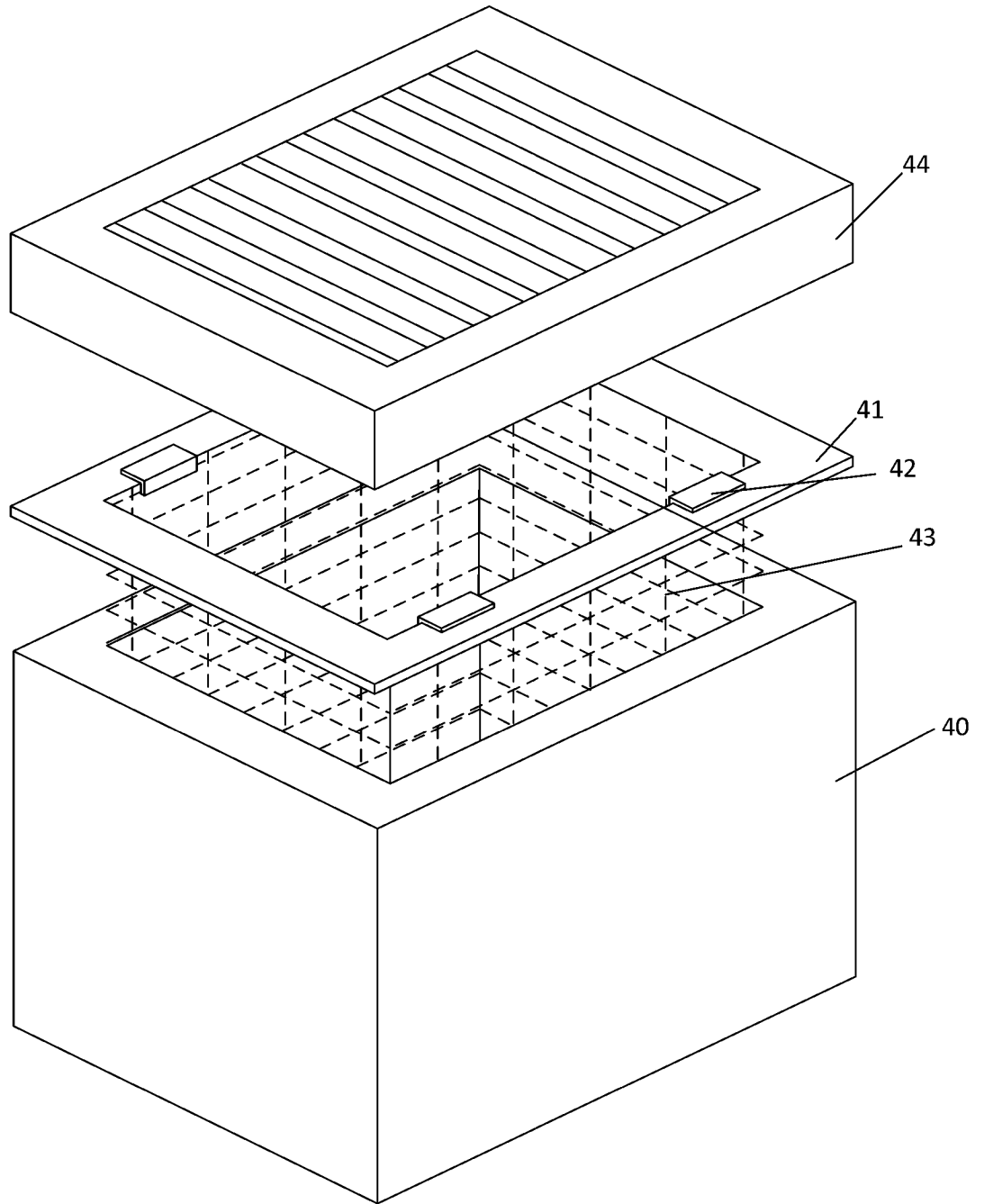


Figure 9

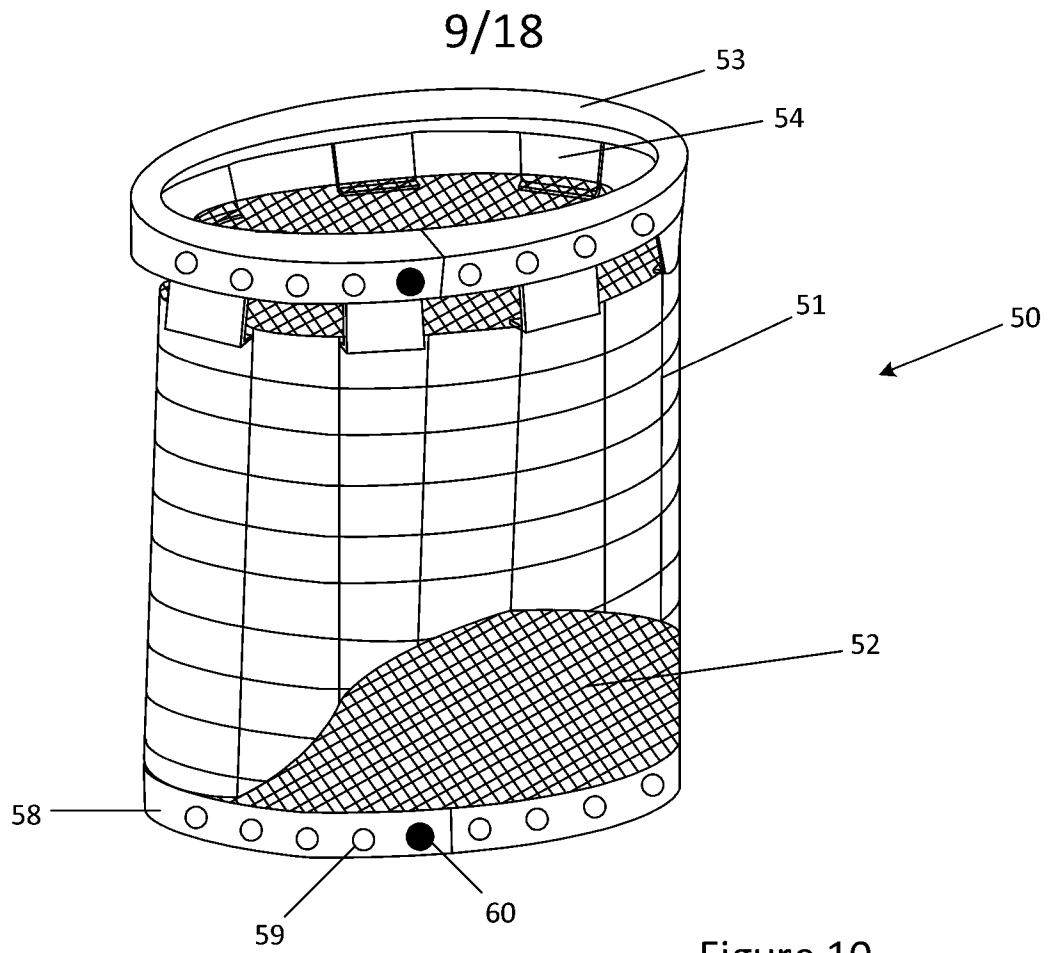


Figure 10

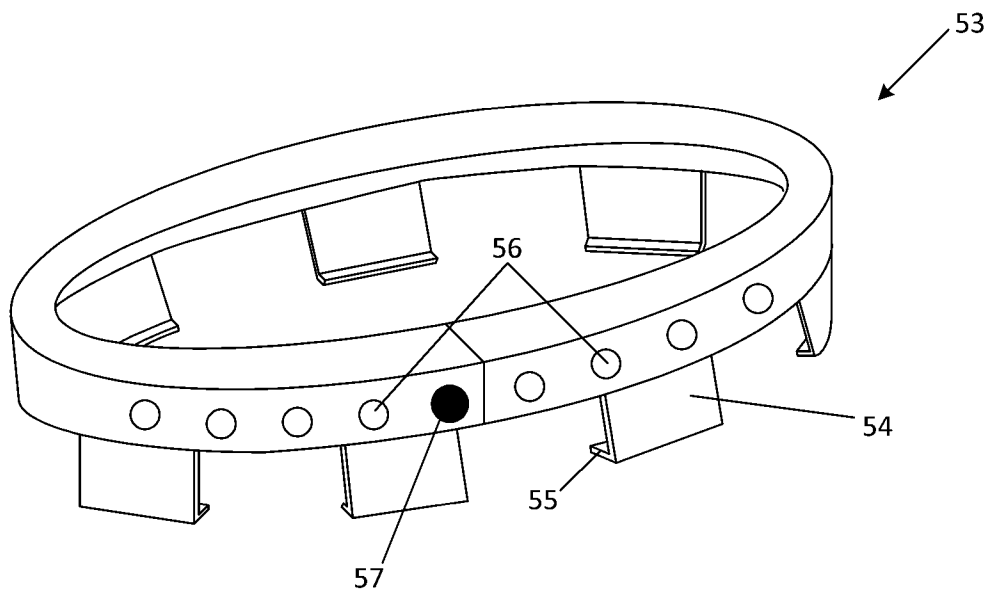


Figure 11

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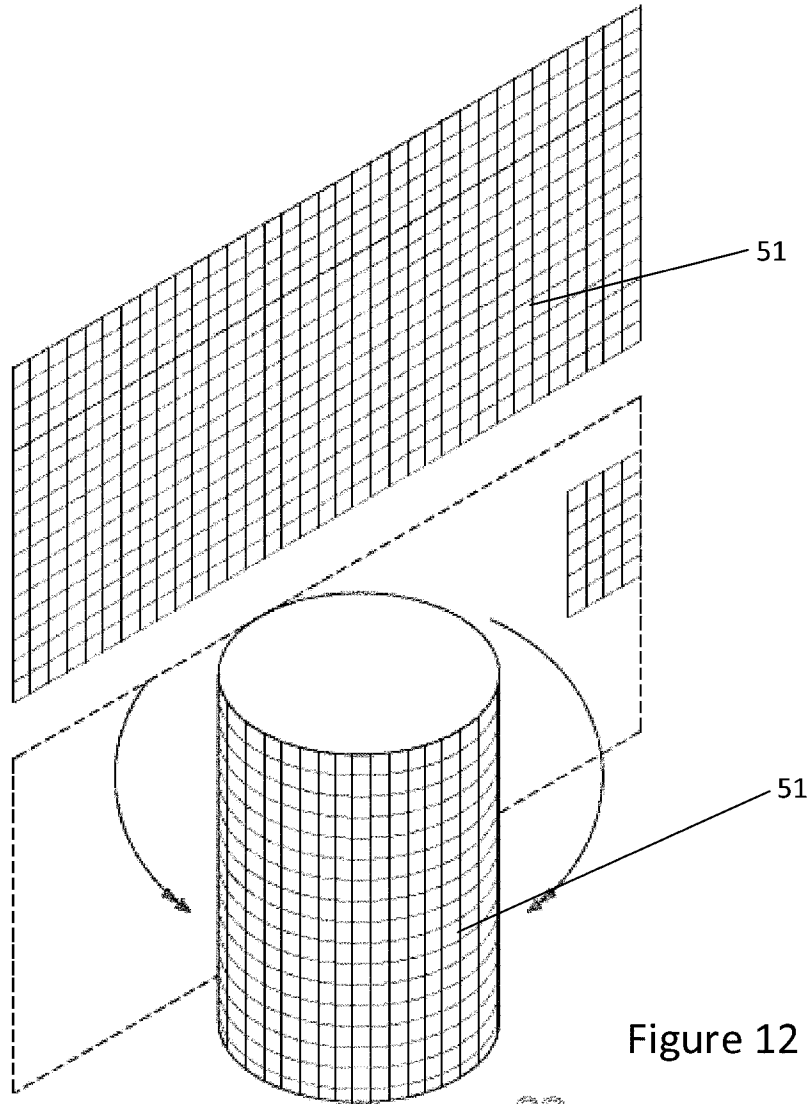


Figure 12

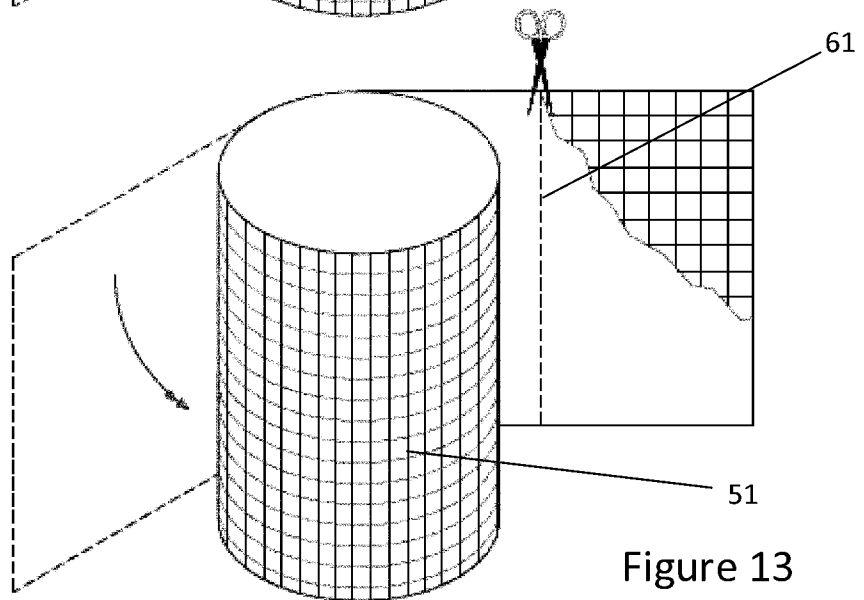


Figure 13

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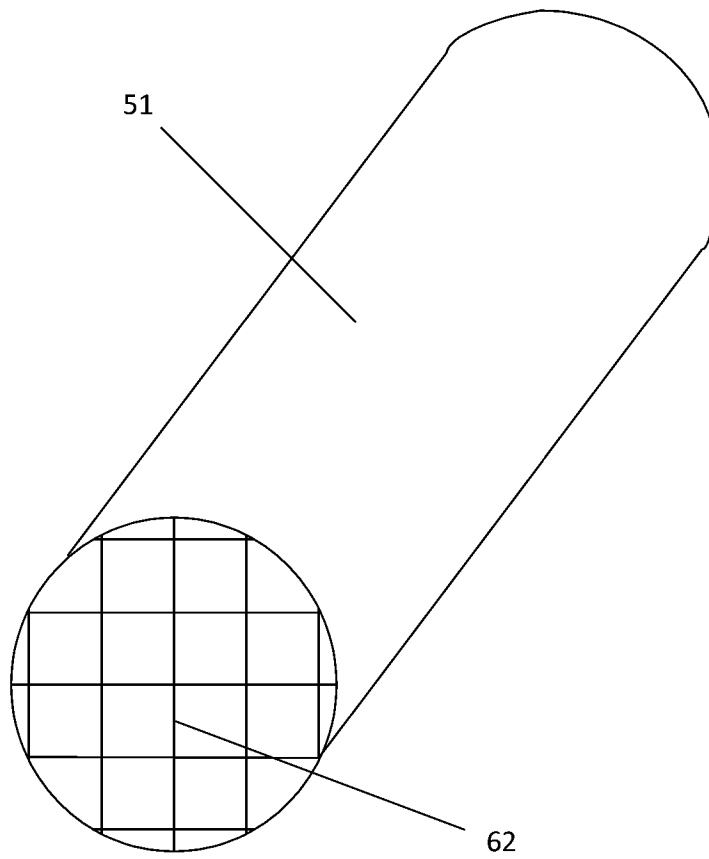


Figure 14

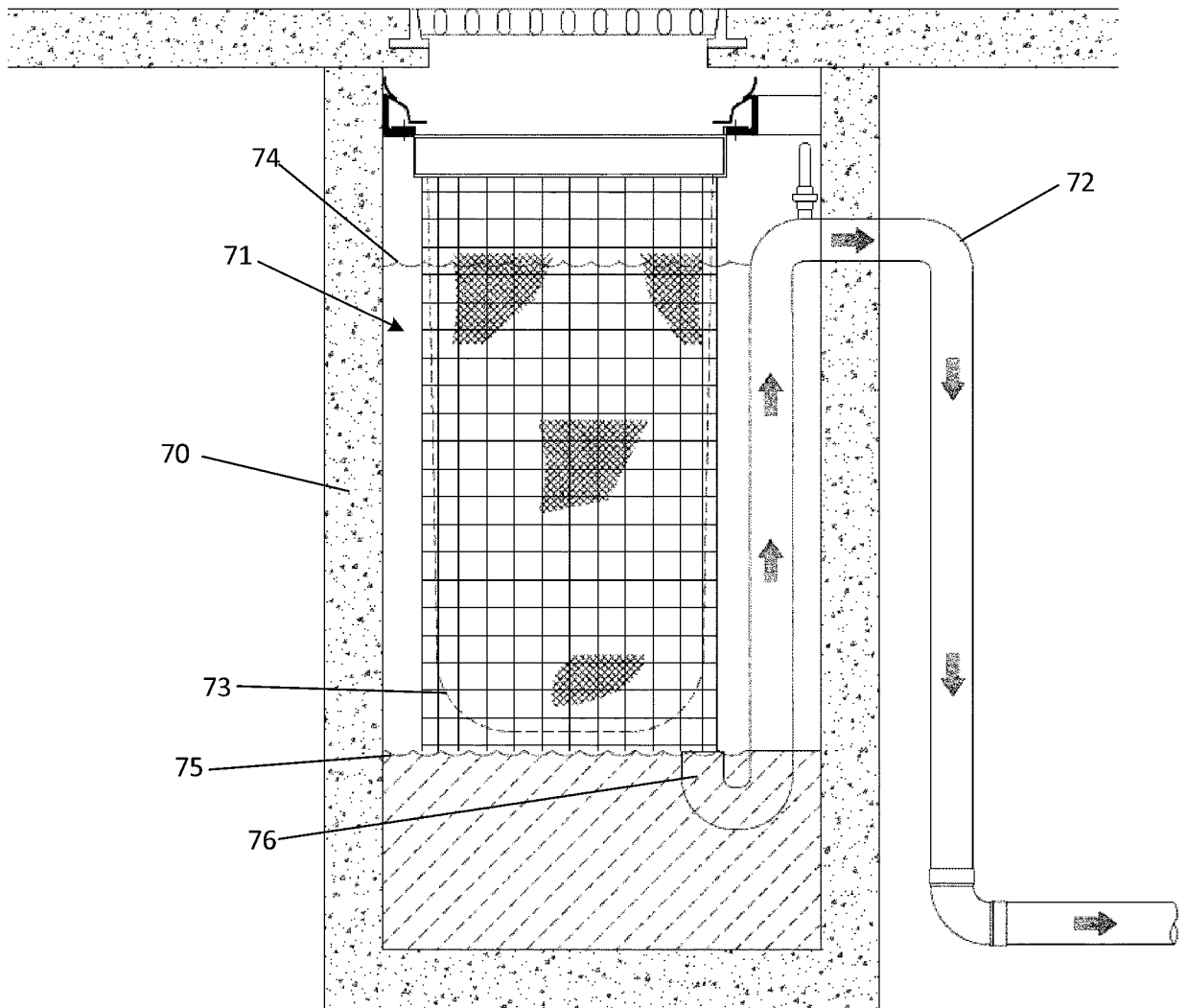


Figure 15

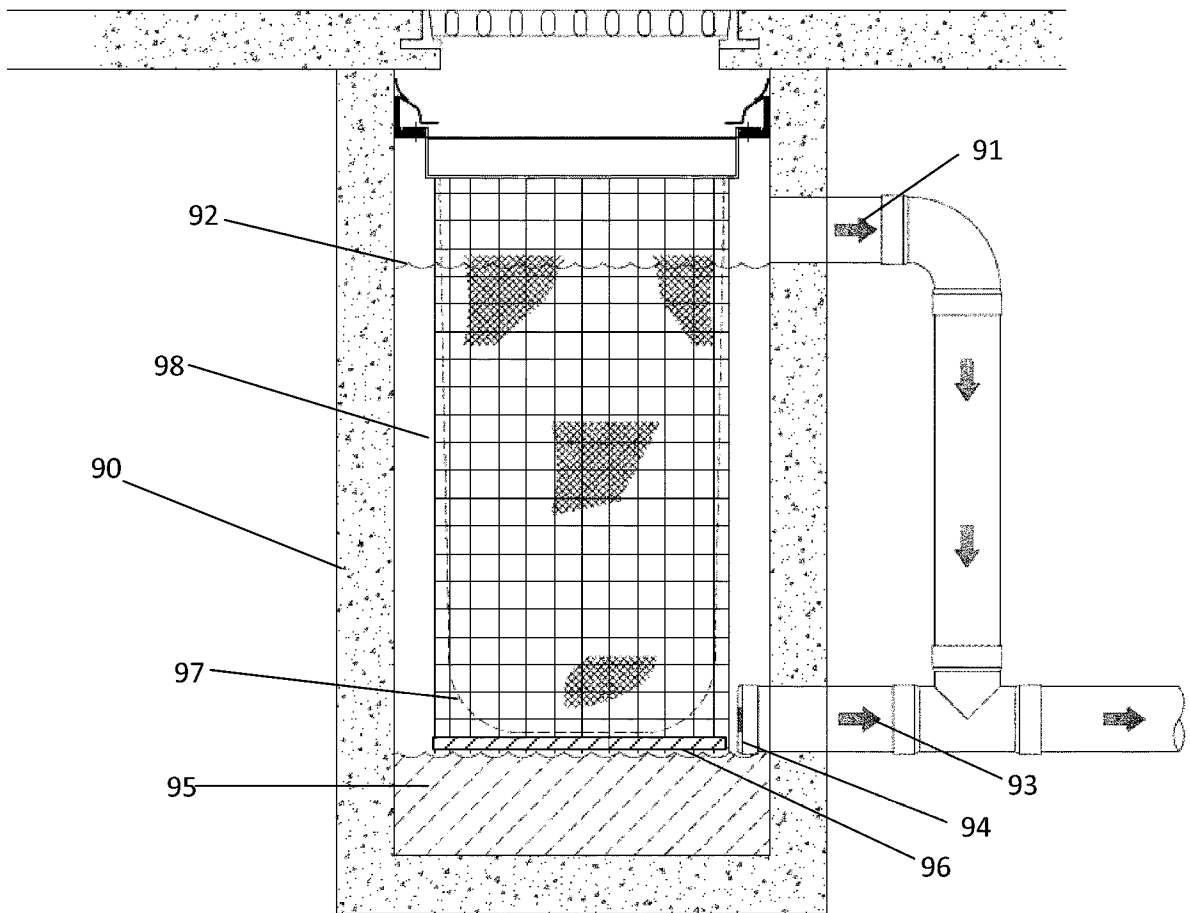


Figure 16

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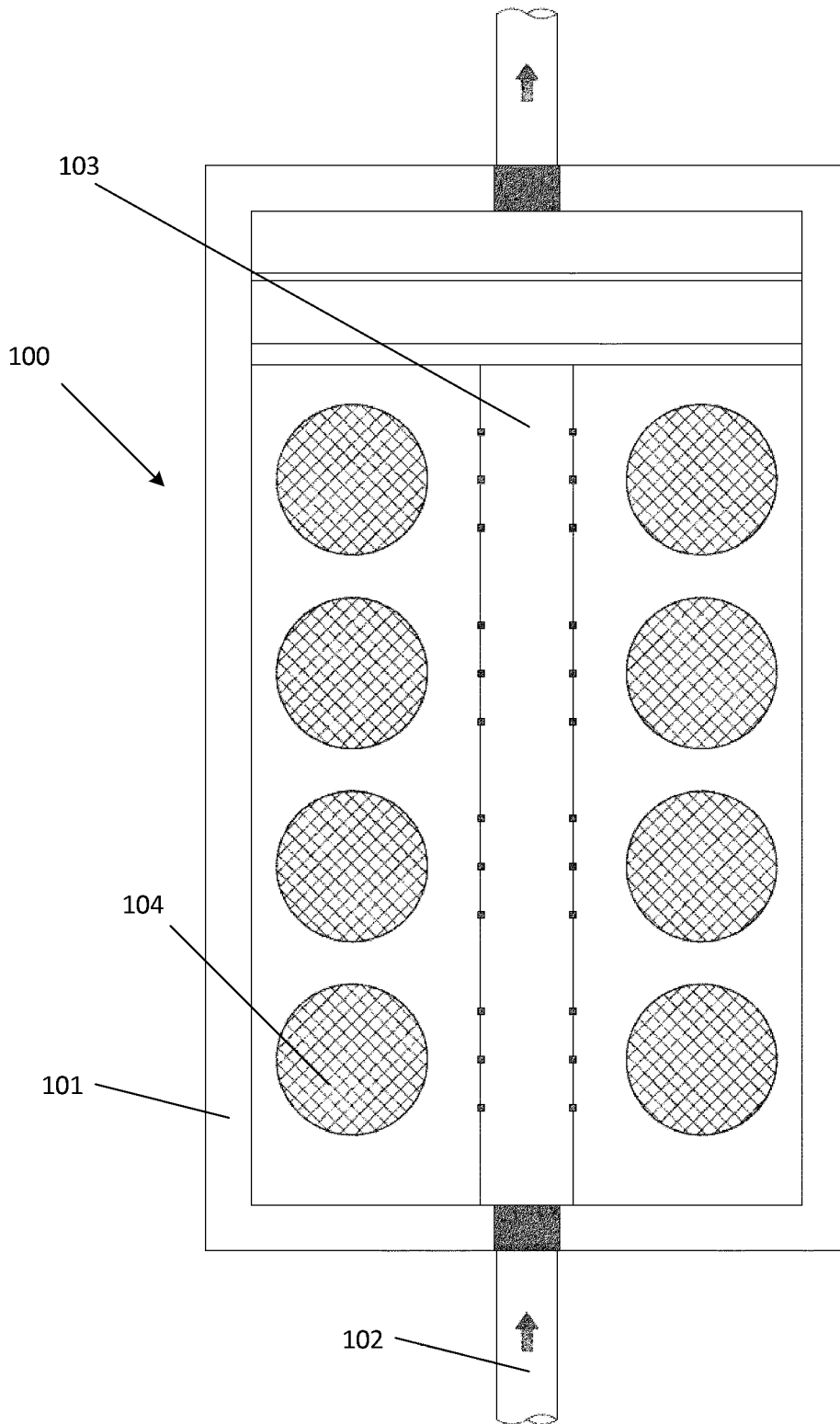


Figure 18

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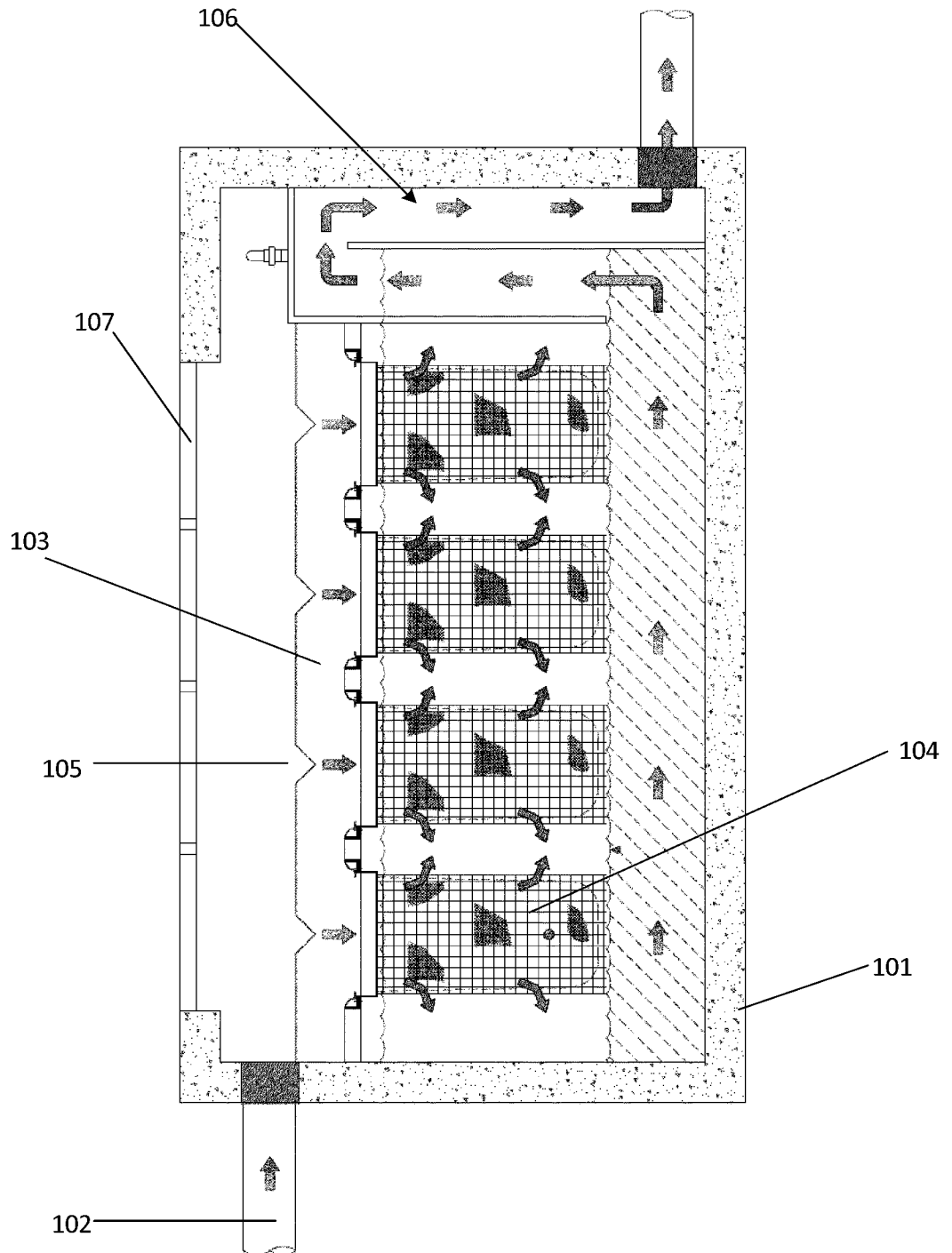


Figure 19

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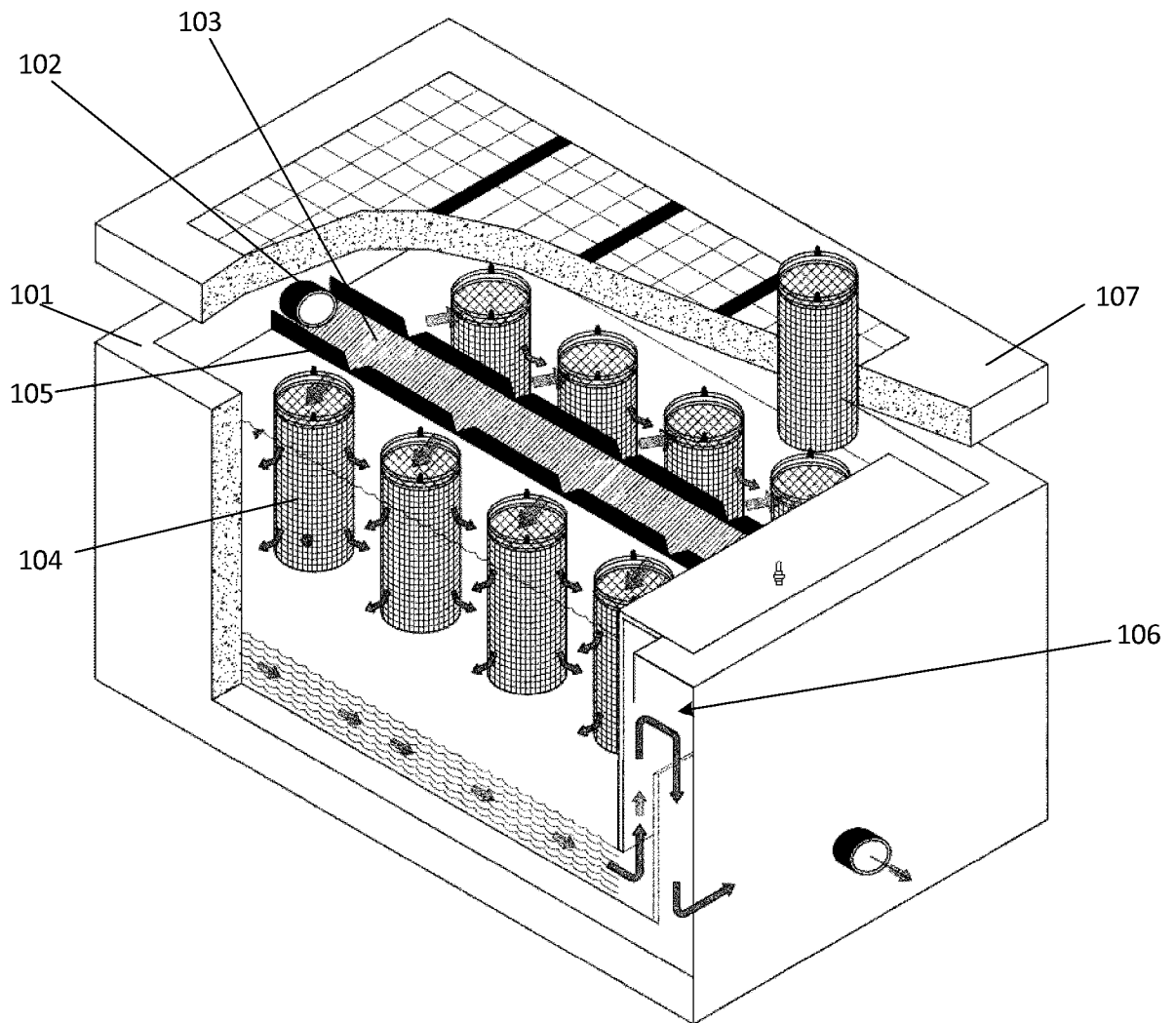


Figure 20

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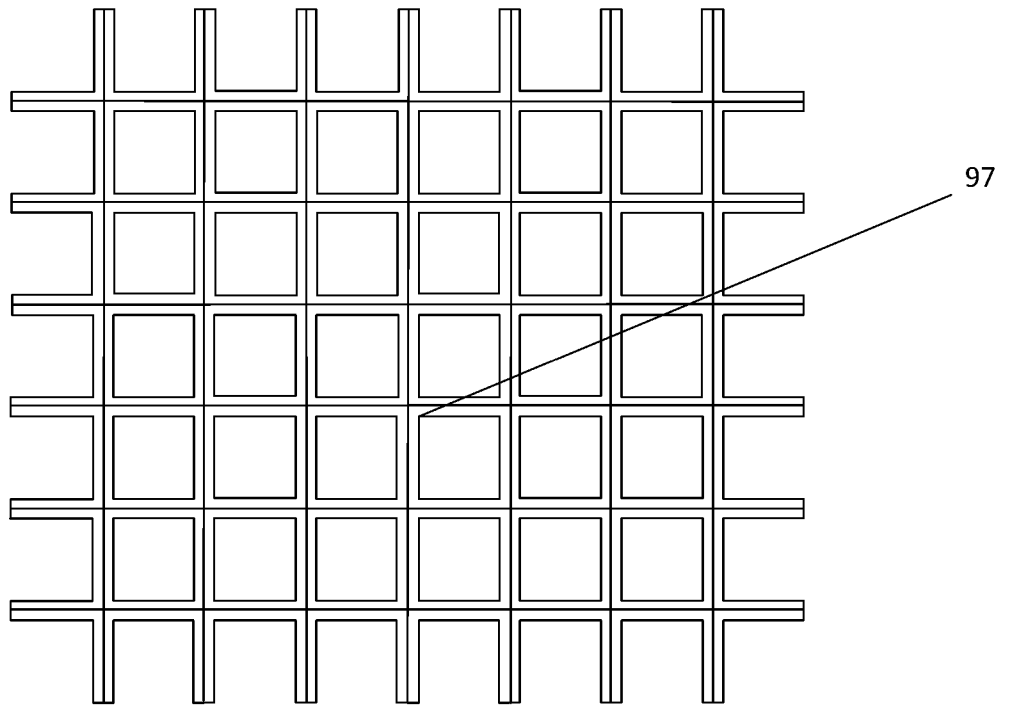


Figure 21

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ2017/050057

A. CLASSIFICATION OF SUBJECT MATTER

E03F 5/20 (2006.01) E03F 5/10 (2006.01) E03F 5/14 (2006.01) E03F 5/04 (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)

DATABASES: PATENW; IPC/C/CNO/LOW: E03f5/20, E03f5/105, e03f5/14, e03f5/04, ; Keywords: Stormwater, Runoff, Lower, Higher, Flow, Level, Flow, Control, Siphon, Syphon, Filter, Drain, Outlet, Entry, Restrict, Reduce and similar keywords.

ESPACENET AND AUSPAT: Applicant/Inventor name searched; Viewed cited/citing of relevant documents.

Google patents: Stormwater, tank, siphon, syphon; Stormwater, filter, tank, siphon; Stormwater, flow control, siphon; Flow control, stormwater; Stormwater, flow control, syphon

Applicant(s)/Inventor(s) name searched in internal databases provided by IP Australia.

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

* Special categories of cited documents:		
"A" 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
1 September 2017Date of mailing of the international search report
01 September 2017

Name and mailing address of the ISA/AU

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INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/NZ2017/050057
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/0374332 A1 (HANNAH et al.) 25 December 2014 See abstract, figure 4 and para [0054]	1 - 10 and 44
A	WO 1990/015311 A1 (ANDERSSON ALF) 13 December 1990 Entire document	1 - 10 and 44
A	WO 1991/014054 A1 (UPONOR N.V) 19 September 1991 Entire document	1 - 10 and 44
A	DE 3640339 A1 (STAHN ROLF) 09 June 1988 Entire document	1 - 10 and 44
A	DE 3808297 A1 (SCHILLING WOLFGANG) 21 September 1989 Entire document	1 - 10 and 44
A	NZ 336761 A (ENVIROPOD HOLDINGS LTD) 26 January 2001 Entire document	11 - 29 and 45

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including
2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1 - 10 and 44

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

Supplemental Box**Continuation of: Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1 – 10 and 44 are directed to a stormwater drain pit including a flow control system. The feature of a flow control system having a first and second level, with the second level 0.3 metres higher than the first level is specific to this group of claims.
- Claims 11 – 29, 45 are directed to a collapsible frame for supporting a stormwater drain bag. The feature of a plurality of rigid side panels and a base panel connected together by hinge joints is specific to this group of claims.
- Claims 30 – 43, 46, 47 – 52 are directed to a frame for supporting a stormwater drain bag including a perforated sheet formed into a cylinder having bands at the top and bottom. The features of a perforated sheet formed into a cylinder is specific to this group of claims.
- Claim 53 is directed to a frame for supporting a stormwater drain bag. The feature of a flotation layer is specific to this group of claims.
- Claim 54 – 63 is directed to a stormwater filter system. The features of a plurality of pit inserts in the form of perforated frames supporting filter bags and a flow distributor is specific to this group of claims.
- Claims 64 – 68 are directed to a band for forming a frame for pit insert. The features of a flat strip having support brackets provided at intervals is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a priori*.

Please note: Whilst claims 45 and 46 are appended to claim 1, they define features of the second invention (claims 11 - 29) and the third invention (claims 30 - 43, 47 - 52) respectively and as such, have not been searched.

INTERNATIONAL SEARCH REPORT		International application No.			
Information on patent family members		PCT/NZ2017/050057			
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.					
Patent Document/s Cited in Search Report		Patent Family Member/s			
Publication Number	Publication Date	Publication Number	Publication Date		
US 2014/0374332 A1	25 December 2014	US 2014374332 A1	25 Dec 2014		
		US 9624658 B2	18 Apr 2017		
		AU 2011302712 A1	18 Apr 2013		
		AU 2011302712 B2	24 Nov 2016		
		CA 2810974 A1	22 Mar 2012		
		EP 2616601 A1	24 Jul 2013		
		NZ 588049 A	28 Jun 2013		
		WO 2012036569 A1	22 Mar 2012		
		WO 1990/015311 A1	13 December 1990	WO 9015311 A1	13 Dec 1990
WO 1990/015311 A1	13 December 1990	DK 186091 A	04 Dec 1991		
		FI 97569 B	30 Sep 1996		
		FR 2668593 A1	30 Apr 1992		
		FR 2668593 B1	12 Mar 1993		
		NO 914739 A	05 Dec 1991		
		SE 466364 B	03 Feb 1992		
		US 5273067 A	28 Dec 1993		
		WO 1991/014054 A1	19 September 1991	WO 9114054 A1	19 Sep 1991
		WO 1991/014054 A1	19 September 1991	AU 7576891 A	10 Oct 1991
EP 0530203 A1	10 Mar 1993				
EP 0530203 B1	01 Jun 1994				
SE 465882 B	11 Nov 1991				
DE 3640339 A1	09 June 1988			DE 3640339 A1	09 Jun 1988
DE 3808297 A1	21 September 1989	DE 3808297 A1	21 Sep 1989		
NZ 336761 A	26 January 2001	NZ 336761 A	26 Jan 2001		
		AU 4517100 A	18 Jan 2001		
		AU 780521 B2	24 Mar 2005		
End of Annex					

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

Form PCT/ISA/210 (Family Annex)(July 2009)