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(71) Applicant: **EHL LIMITED** [NZ/NZ]; 7c Piermark Drive,
Rosedale, Auckland, 0632 (NZ).

(72) Inventors: **YEOMAN, Gregory Paul**; 12 Ridge Road,
Oneroa, Waiheke Island, 1081 (NZ). **HANNAH, Michael
Morton**; 25 Lawrence Street, Herne Bay, Auckland, 1011
(NZ).

(74) Agent: **ELLIS TERRY** et al.; PO Box 10932, The Terrace,
Wellington, 6143 (NZ).

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(54) Title: A STORM WATER DRAIN SYSTEM AND COMPONENTS THEREOF AND METHODS OF USE

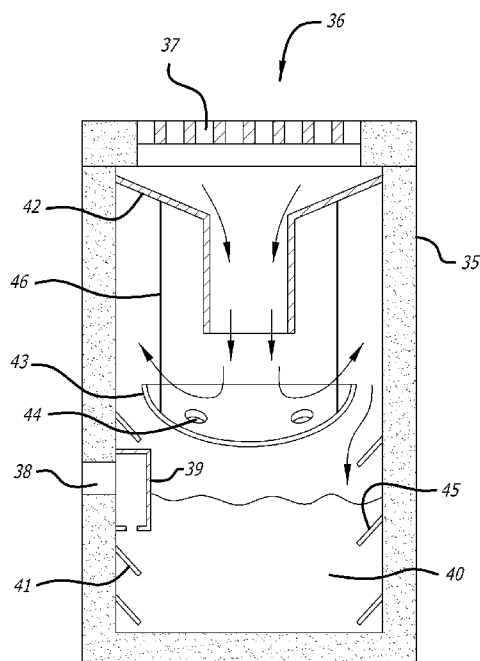


FIG. 5

(57) Abstract: A method of removing sediment from fluid flow within a storm water drain pit by deflecting flow entering the pit towards the side walls of the pit by one or more deflectors. This reduces the energy of the fluid flow and promotes settling of sediment within the catch pit. Each deflector is preferably of a concave form and may be located in a storm water drain pit bag or suspended. A removable catch basin receptacle for a storm water drain pit includes a container has a low flow outlet defining a fluid path for fluid at a first level within the container to a second level, higher than the first level, outside the container. An overflow path provides a fluid flow path out of the container at a level higher than the first or second level.

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A STORM WATER DRAIN SYSTEM AND COMPONENTS THEREOF AND METHODS OF USE**FIELD OF THE INVENTION**

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

BACKGROUND OF THE INVENTION

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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 known as catchpits, gully traps, catch basins and stormwater inlets. In many situations it is desirable to retain contaminants at the point of entry to the stormwater system and to periodically remove them to avoid blockage and contamination of the stormwater drainage system. A wide variety of storm water drain systems and components have been developed for this purpose including those described in the applicant's prior applications PCT/NZ2011/000193 and PCT/NZ2017/050057, the disclosure of which is hereby incorporated by reference.

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Desirable features of a stormwater drain system are:

- 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;
- 25 • To remove and retain gross particulate matter within the catchpit;
- To remove and retain sediment suspended in the incoming flow within the catchpit;
- 30 • To prevent mosquitos breeding within the sump in mosquito prone areas; and
- to allow easy maintenance by hand, without the requirement for mechanical lifting or induction by vacuum truck.

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It can be difficult to improve the performance of existing pits without expensive modification and providing enhanced features within the catchpit itself may also be expensive.

5 It is an object of the invention to provide an improved storm water drain system and components and methods of operation 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
10 prior art forms part of the common general knowledge.

SUMMARY OF THE INVENTION

According to one exemplary embodiment there is provided a method of removing
15 sediment from fluid flow within a storm water drain pit comprising deflecting flow entering the pit towards the side walls of the pit by one or more deflectors so as to reduce the energy of the fluid flow and promote settling of sediment within the catch pit.

According to another exemplary embodiment there is provided a removable catch basin
20 receptacle for a storm water drain pit comprising a container having:

- a. a base and side walls defining an opening at the top of the container;
- b. a low flow outlet defining a fluid path for fluid at a first level within the container to a second level, higher than the first level, outside the container; and
- c. an overflow path providing a fluid flow path out of the container at a level higher
25 than the first or second level.

According to a further exemplary embodiment there is provided a storm water drain system including a catchpit having one or more deflector within the catchpit configured to redirect fluid flow entering the catchpit outwardly and upwardly towards the side walls
30 of the catchpit.

3**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 embodiments given below, serve to explain the principles of the invention.

Figure 1 shows a cross-sectional side view of a storm water drain system including a removable catch basin receptacle with a gross pollutant basket;

Figure 2 shows a cross-sectional side view of a storm water drain system including a removable catch basin receptacle with a gross pollutant basket and a deflector;

Figure 3 shows a perspective view of a storm water drain system including a removable catch basin receptacle with an outlet bay, a gross pollutant basket and a deflector;

Figure 4 shows an exploded perspective view of the storm water drain system shown in Figure 3; and

Figure 5 shows a cross-sectional side view of a storm water drain system including a suspended deflector.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Referring to Figure 1 there is shown a storm water drain system in which a removable catch basin receptacle 6 is provided within a conventional catchpit 1. The catchpit 1 has an inlet 2, outlet 3, entry grate 4 and inspection port 5. Such a conventional catchpit has an outlet located near the base and so does not retain a standing sump of water.

It has been found that providing a standing sump of water and dissipating the energy of fluid flow into a catchpit can greatly enhance the settling and retention of sediment within the catchpit. Whilst either technique alone is beneficial the combination of both techniques may be particularly beneficial.

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Figure 1 shows a removable catch basin receptacle 6 for a storm water drain pit including a single container having side walls 7 and a base 8. The receptacle is removable and may be retrofitted to existing catchpits or installed in new catchpits. A mesh basket 9 may be provided over the opening to the receptacle to collect gross pollutants, with the size of mesh determining the size of gross pollutants removed. These gross pollutants may be removed by periodically emptying basket 9. A gasket 10 provides a seal between to opening of the receptacle and basket 9 to ensure that flow goes through the receptacle during normal operation.

During normal operation a sump of standing water 11 remains in the receptacle 6. The level of this sump water is controlled by a low flow outlet. In this case the low flow outlet is in the form of a conduit formed by a division 12 running between opposite side walls 7 of the container which defines a fluid path from a first level at inlet 13 to a second level at outlet 14. This ensures that floatable materials and oils etc. are retained within the receptacle and prevents the entry of mosquitos etc. The size on the inlet orifice 13 may be dimensioned to provide desired flow characteristics for a specific application.

Basket 9 will act to dissipate energy of the incoming flow and standing sump water 11 will further remove energy from the flow. This and the outlet flow path assist in removing suspended sediment from the incoming flow. Sediment collected within the receptacle may be periodically removed. The basket 9 keeps large particulate material above the sump water level to keep it dry between inflows.

During high flow conditions the receptacle may fill at a rate faster than the outlet can remove it and under these conditions the top edge of the receptacle defines a bypass flow path with the excess flow simply flowing over the edge of the receptacle.

Figure 2 shows the storm water drain system shown in Figure 1 with a deflector 15 provided in the base of basket 9. In this case the deflector 15 is in the form of a concave parabolic dish. The deflector 15 serves to redirect the majority of incident flow from the inlet 2 upwardly and outwardly, removing much of the energy from the flow. The fluid then flowing down the side walls is retarded due to cohesion with the side walls. Baffles

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may be added to the side walls to further remove energy from the flow. When the retarded flow reaches the sump water 11 much of its energy has been removed and it further settles to release sediment into the base of the container.

5 Referring now to Figures 3 and 4 a receptacle 16 is shown having a container 17 and an outlet bay 18. The catchpit entry may include a curb entry lintel 19 and access grate 20. Filter basket 21 includes a flange 22 to support the basket above and seal with respect to container 17. Flow from the inlet is directed into filter basket 21 which collects gross particulate material. The basket 21 has a deflector 23 positioned in its base, although it
10 could be suspended within the filter bag above the base of the bag. The deflector 23 may be of a concave, parabolic dish form with drainage holes 24. It will however, be appreciated that other deflector shapes may be effective in retarding and dispersing an incident flow. Flow deflected upwardly and outwardly by deflector 23 may be retarded by or pass through the mesh of basket 21 towards walls 25. One or more of the walls 25
15 bay be provided with one or more baffles 26 to retard flow as it flows down the walls. The baffles may be in the form of a plurality of deflectors angled outwardly and downwardly from the side walls although other shapes may achieve the same effect.

During normal operation a sump of standing water S remains in the container 17. The
20 level of this sump water is controlled by a low flow outlet. In this case the low flow outlet is in the form of a pair of elbows 27 and 28 which define a fluid path from a first level at inlets 29 and 30 to a second level at outlets 31 and 32. This ensures that floatable materials and oils etc. are retained within the container 17 and prevents the entry of mosquitos etc. The size on the inlet orifices may be dimensioned to provide desired flow
25 characteristics for a specific application.

During high flow conditions the container 17 may fill at a rate faster than the low flow outlets can remove it and under these conditions a lowered section 33 in a wall between container 17 and outlet bay 18 defines a bypass flow path with the excess flow simply
30 flowing over the edge of the receptacle into the outlet bay and exiting via outlets 34.

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By controlling the level of sump water S within container 17 and deflecting the flow just above the sump water level S energy may be effectively removed from the flow. The retarded flow may then settle within the standing sump region S promoting suspended sediment to drop out of the flow for collection within container 17. The bottom of the basket 21 is at a height above the sump water level and so gross particulate matter is kept dry between periods of flow.

In the above examples the basket may have a mesh size of 1mm or less if mosquito exclusion is required. In other cases a mesh size of about 5mm may be appropriate. An energy dissipater may be provided in the base of a basket or bag to further dissipate energy in the flow. A contaminant absorbing bag may also be provided in the receptacle to remove hydrocarbons etc.

The receptacles may be formed of plastics, fiberglass, fibre reinforced plastics, metal or other suitable material. Lateral flexible flanges may be provided around the top edges of the receptacle edges to seal against the catchpit walls.

Referring now to Figure 5 a simplified design without a basket or receptacle will be described. A catchpit 35 has an inlet 36 covered by a grate 37 and a catchpit outlet 38. A conduit 39 provides a fluid outlet path from a lower level within sump 40 to the outlet 38. One or more check dams 41 may also be provided at the inlet to conduit 39 to further retard fluid flow.

A funnel 42 is provided below inlet 36 to direct incident flow towards the centre of a deflector 43. Whilst not essential the funnel ensures better distribution by the deflector 43. Deflector 43 may be of a generally flat form or a concave, parabolic dish form with drainage holes 44. It may be suspended by cables or rods etc. from funnel 42 or from the grate or may be mounted to a side wall of the pit. It will be appreciated that other deflector shapes may be effective in retarding and dispersing an incident flow.

Fluid deflected upwardly and outwardly by deflector 43 loses much of its energy before contacting the side walls of catchpit 35. One or a series of deflectors 45 may be provided

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on one or more side walls of the catchpit 35 to retard flow as it moves down the walls into sump water 40. The de-energised sump water settles and its outward flow is controlled by conduit 39 and check dam 41 to promote the settling of sediment out of the flow to be collected in the base of the catchpit.

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There are thus provided systems that may be fitted to new catchpits or retrofitted to existing catchpits. New catchpits of simple design may be provided with enhanced functionality whilst existing catchpits may be provided with a sump of standing water providing enhanced performance that may otherwise require expensive modification.

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The use of deflectors removes energy from the flow, lowers flow velocity, changes flow direction, entrains air, and extends the flow path to allow suspended material to drop out for collection in the catchpit.

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The maintenance of a level of sump water dissipates the energy of the incident flow and allows settling out of sediment from the flow. Where a bag is provided at the sump water level the sump water level dissipates energy at the base of the bag.

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The receptacle captures both suspended particulates and floating contaminants (e.g. oil). Baskets capture gross solids and holds them dry, preventing decomposition in sump water. The baskets are easily removable to provide access to sump for cleaning. Trapped material is thus kept out of the water flow (even during high flow) reducing contamination of exiting water. Bypass flow paths allow peak water flows in large storms without restriction beyond the inherent capacity of the catchpit.

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Experiments have shown increased suspended sediment removal of around 40% - 75% for a given particle size and flow rate when employing a receptacle when compared to a standard pit.

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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 departure from the spirit or scope of the Applicant's general inventive concept.

CLAIMS:

- 5 1. A method of removing sediment from fluid flow within a storm water drain pit comprising deflecting flow entering the pit towards the side walls of the pit by one or more deflectors so as to reduce the energy of the fluid flow and promote settling of sediment within the catch pit.
- 10 2. A method as claimed in claim 1 wherein flow is redirected upwardly and towards the walls of the pit by the one or more deflectors.
3. A method as claimed in claim 1 or claim 2 wherein the majority of the fluid flow entering the pit is redirected by the one or more deflectors.
- 15 4. A method as claimed in any one of the preceding claims wherein baffles are provided on the walls of the pit to further retard fluid flow down the pit walls.
- 20 5. A method as claimed in any one of the preceding claims wherein a receptacle is provided within the pit to receive flow entering the drain and retain suspended sediment.
6. A method as claimed in claim 5 wherein the receptacle includes a flow outlet defining a fluid path for fluid at a first level within the receptacle to a second level, higher than the first level, outside the receptacle.
- 25 7. A method as claimed in any one of the preceding claims wherein a filter bag is provided in the fluid flow path to retain gross particulate material.
8. A removable catch basin receptacle for a storm water drain pit comprising a container having:
- 30 a. a base and side walls defining an opening at the top of the container;

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- 5 b. a low flow outlet defining a fluid path for fluid at a first level within the container to a second level, higher than the first level, outside the container; and
- c. an overflow path providing a fluid flow path out of the container at a level higher than the first or second level.
- 10 9. A receptacle as claimed in claim 8 wherein the low flow outlet is in the form of one or more conduit each having a first open end at the first level and second open end passing through a side wall of the container at the second level.
- 15 10. A receptacle as claimed in claim 8 wherein the low flow outlet is in the form of a divider between side walls of the container defining a channel from the first level to an outlet passing through a side wall of the container at the second level.
- 20 11. A receptacle as claimed in any one of claims 8 to 10 wherein one or more check dam is provided near the inlet to the low flow outlet.
12. A receptacle as claimed in any one of claims 8 to 11 wherein the overflow path is a lowered edge on a wall of the container.
- 25 13. A receptacle as claimed in any one of claims 8 to 12 wherein baffles are provided on interior walls of the receptacle to retard fluid flow down the walls.
14. A receptacle as claimed in claim 13 wherein the baffles are in the form of a plurality of deflectors angled outwardly and downwardly from the side walls.
- 30 15. A receptacle as claimed in any one of claims 8 to 14 including an outlet bay positioned adjacent a side wall of the container receiving fluid from the low flow outlet and overflow path.

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16. A receptacle as claimed in claim 15 wherein the outlet bay includes an outlet at its base.
- 5 17. A receptacle as claimed in any one of claims 8 to 16 including a filter bag at the opening of the container to retain gross particulates.
18. A receptacle as claimed in claim 17 wherein a deflector is provided within the filter bag.
- 10 19. A receptacle as claimed in claim 18 wherein the deflector is configured to direct incident fluid flow outwardly and upwardly.
20. A receptacle as claimed in claim any one of claims 17 to claim 19 wherein the bottom of the bag is at a height above the second level.
- 15 21. A storm water drain system including a catchpit including a receptacle as claimed in any one of claims 8 to 20 positioned in the catchpit below the inlet.
- 20 22. A storm water drain system including a catchpit having one or more deflector within the catchpit configured to redirect fluid flow entering the catchpit outwardly towards the side walls of the catchpit.
- 25 23. A system as claimed in claim 22 wherein the one or more deflectors are suspended at the catchpit opening.
24. A system as claimed in claim 22 or claim 23 including a funnel between the catchpit opening and a deflector to focus flow towards a central region of the deflector.
- 30 25. A system as claimed in any one of claims 22 to 24 wherein each deflector has a concave shape.

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26. A system as claimed in claim 25 wherein each deflector is generally in the form of a parabolic dish.
- 5 27. A system as claimed in any one of claims 22 to 24 wherein each deflector is generally flat.
28. A system as claimed in any one of claims 22 to 27 wherein baffles are provided on interior walls of the catchpit to retard fluid flow down the walls.
- 10 29. A system as claimed in claim 28 wherein the baffles are in the form of a plurality of deflectors angled outwardly and downwardly from the side walls.
- 15 30. A storm water drain pit bag formed at least partially of a mesh material including one or more deflector positioned and arranged within the bag to deflect flow entering the bag outwardly and upwardly through side walls of the bag.
31. A bag as claimed in claim 30 wherein each deflector has a concave shape.
- 20 32. A bag as claimed in claim 31 wherein each deflector is generally in the form of a parabolic dish.
33. A bag as claimed in any one of claims 31 to 32 wherein each deflector has one or more aperture for drainage.
- 25 34. A bag as claimed in any one of claims 31 to 33 having a mesh size less than 1mm.
35. A bag as claimed in any one of claims 31 to 34 having permeable and impermeable sections.
- 30 36. A storm water drain system as claimed in any one of claims 21 to 29 including a bag as claimed in any one of claims 30 to 35.

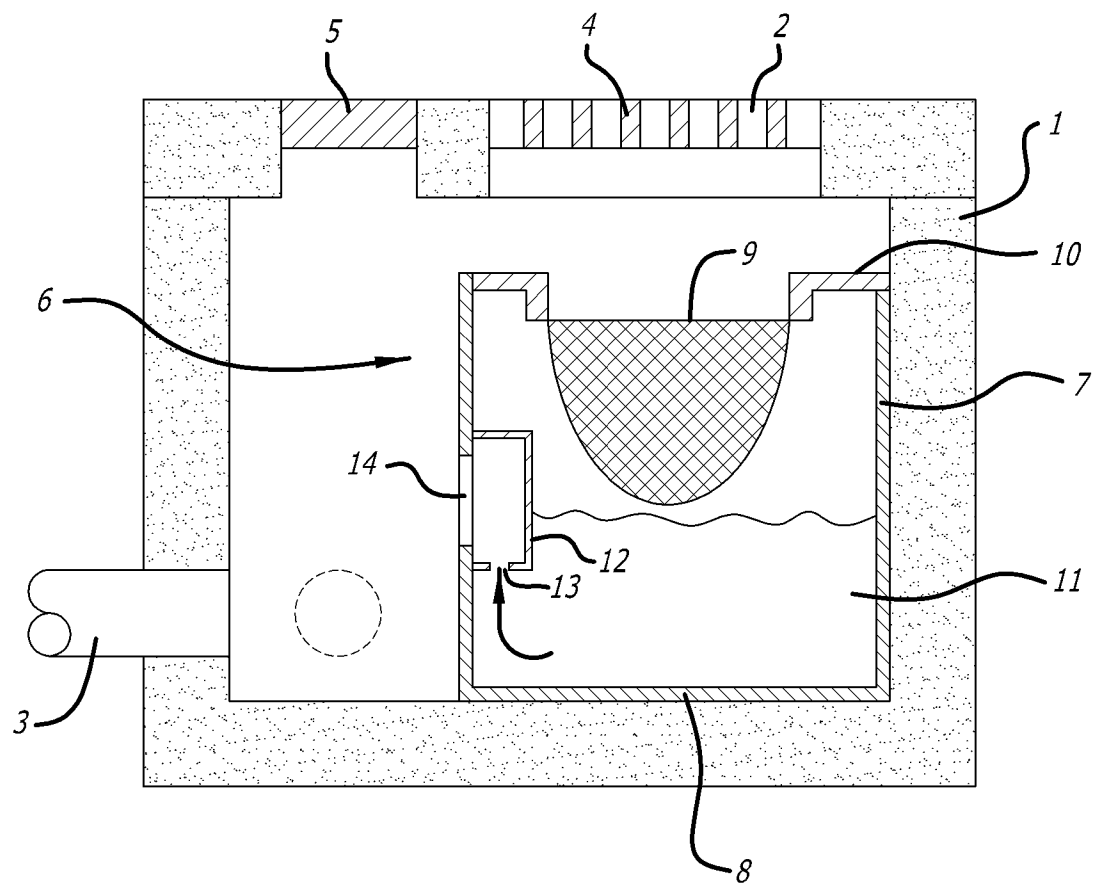


FIG. 1

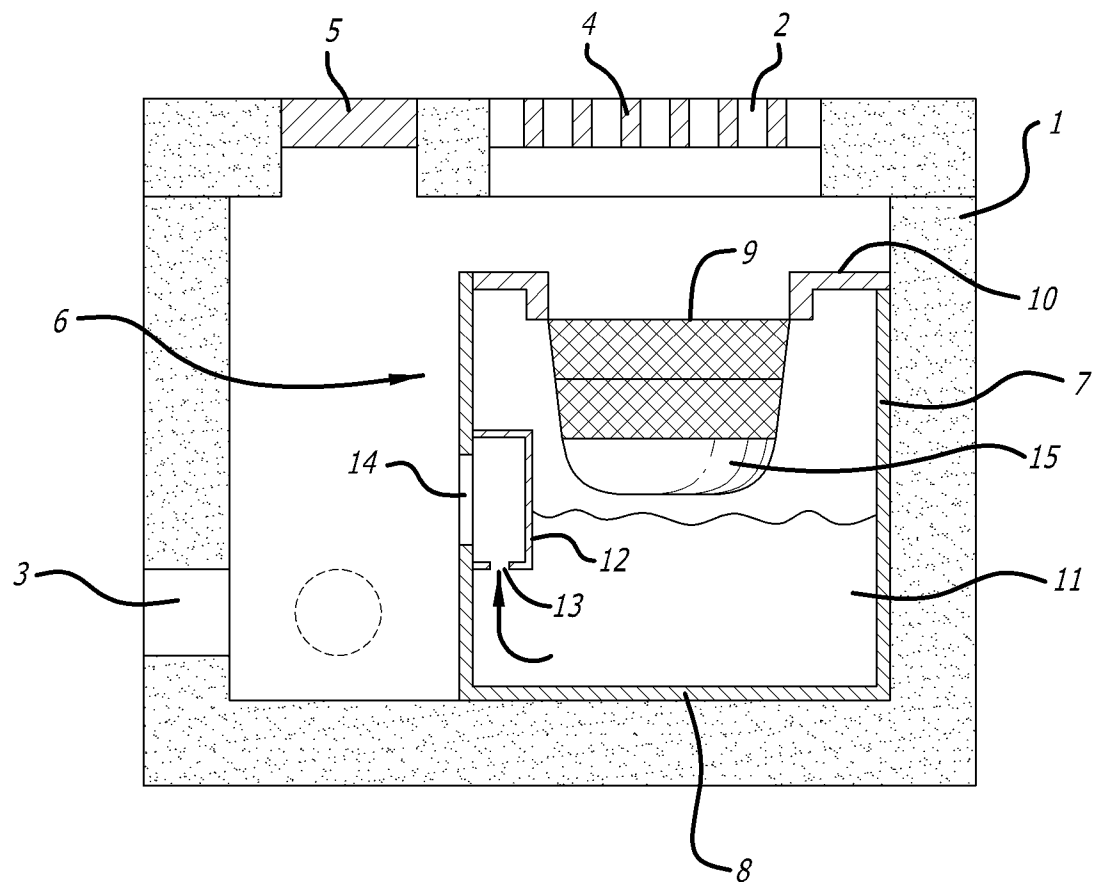
*FIG. 2*

FIG. 3

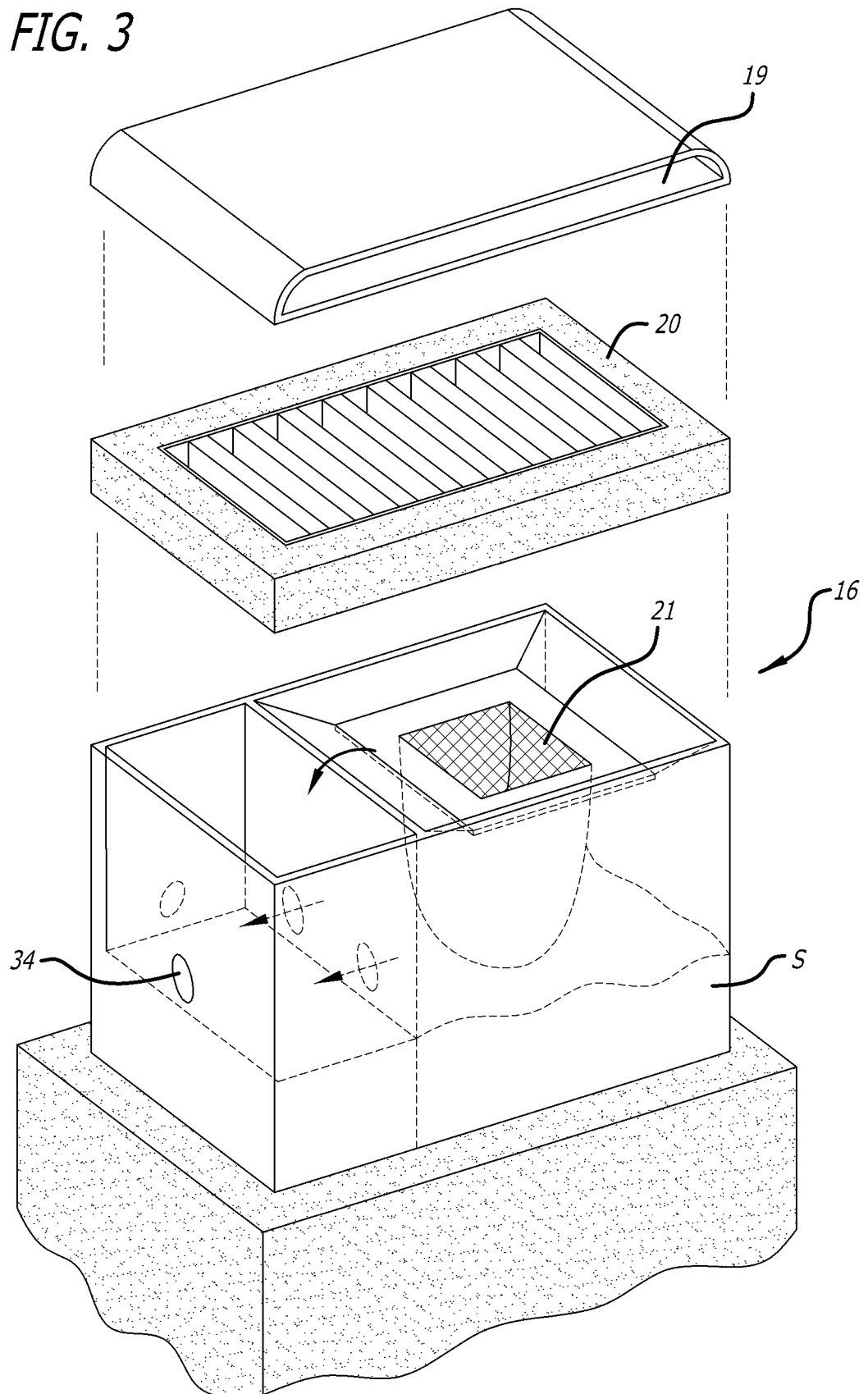
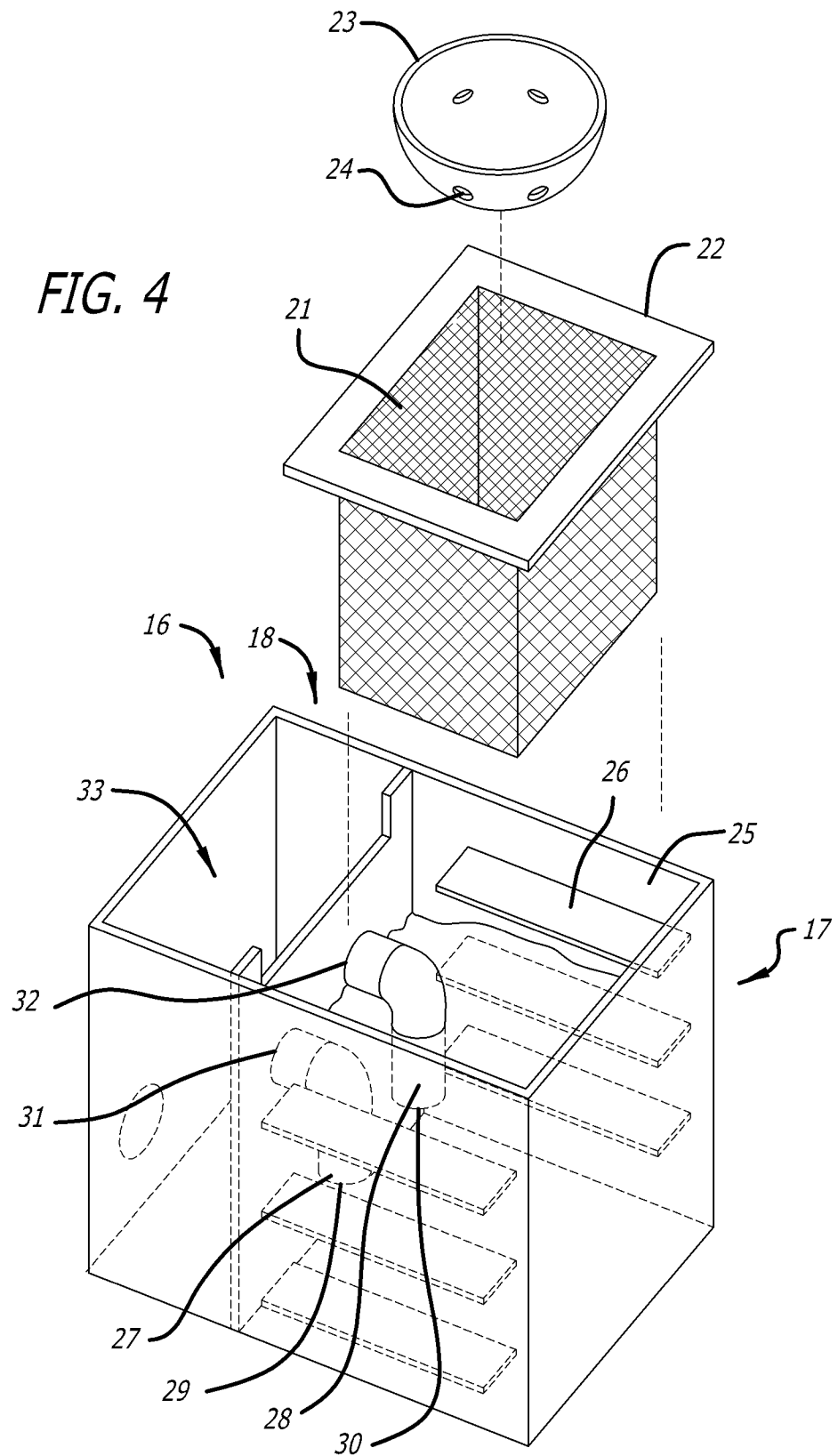
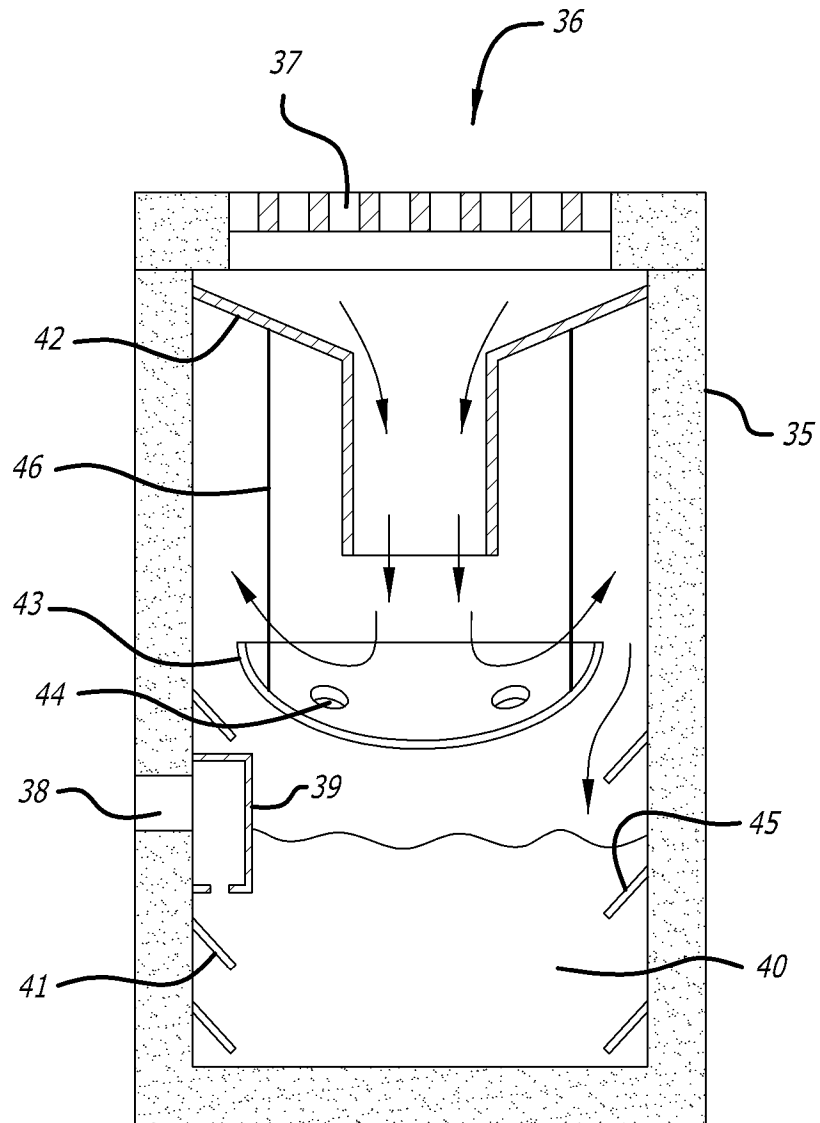


FIG. 4



*FIG. 5*

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/NZ2018/050167

A. CLASSIFICATION OF SUBJECT MATTER

E03F 5/14 (2006.01) E03F 5/16 (2006.01) E03F 5/10 (2006.01) B01D 35/00 (2006.01) B01D 21/00 (2006.01)
B01D 21/02 (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)

DATABASES: PATENW, GOOGLE PATENTS, ESPACENET

IPC/CPC: B01D21, E03F, B01D35

KEYWORDS: (Deflect, plate, retard, flow, arc, catch, pit, mesh, bag) and like terms in various combinations.

Applicant/Inventor searched in Espacenet, Auspat and IP Australia internal databases.

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 25 March 2019	Date of mailing of the international search report 25 March 2019
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au	Authorised officer Parminder Singh AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262256135

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/NZ2018/050167
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 8142666 B1 (HAPPEL) 27 March 2012 See abstract, figures 7, 8, 17-19	1-7, 22-29
Y	See abstract, figures 7, 8, 17-19	30-36
X	US 5378378 A (MEURER) 03 January 1995 See abstract, figures 3B, 4, 6-8 & 17-19 and lines 20-29 of column 4	1-7, 22-29
Y	See abstract, figures 3B, 4, 6-8 & 17-19 and lines 20-29 of column 4	30-36
X	US 2002/0139736 A1 (STEVEY et al.) 03 October 2002 See abstract, figures 2 & 9	1-7, 22-29
Y	See abstract, figures 2 & 9	30-36
Y	WO 2017/196189 A1 (EHL LIMITED) 16 November 2017 See abstract, lines 4-6 of page 3 and figures 10-12, 15 & 16	30-36

Form PCT/ISA/210 (fifth sheet) (revised January 2019)

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.:
1-7 and 22-36

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:

1. Claims 1-7 and 22-36 are directed to a method of removing sediment from fluid flow or to storm water drain system or to storm water drain pit bag. The feature of deflecting the flow entering the pit towards the side walls is specific to this group of claims.
2. Claims 8-21 are directed to a removable catch basin receptacle for storm water drain pit. The feature of a low flow outlet defining a fluid path for fluid at a first level within the container to a second level higher than the first level outside the container 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. The only feature common to all of the claimed inventions is storm water drain pit. However it is considered that this feature is generic in this particular art.

Therefore in this light this common feature cannot be a special technical feature. 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.

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/NZ2018/050167	
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
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