

(12) **UK Patent Application** (19) **GB** (11) **2469017** (13) **A**

(43) Date of A Publication

06.10.2010

(21) Application No: **0903979.3**
(22) Date of Filing: **07.03.2009**

(51) INT CL:
B01D 29/05 (2006.01) **B01D 29/03** (2006.01)
B01D 35/02 (2006.01) **B01D 35/22** (2006.01)
C02F 1/00 (2006.01) **E03B 3/02** (2006.01)
E04D 13/08 (2006.01)

(71) Applicant(s):
Shearline Precision Engineering Ltd
(Incorporated in the United Kingdom)
Precision House, Cambridgeshire Business Park,
Angel Drove, ELY, Cambridgeshire, CB7 4EX,
United Kingdom

(56) Documents Cited:
EP 0358952 A1 **DE 010213816 A1**

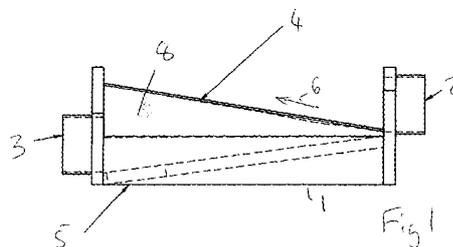
(72) Inventor(s):
David Howard Littlechild

(58) Field of Search:
UK CL (Edition X) **B1D**
INT CL **B01D, C02F, E03B, E04D**
Other: **WPI, EPODOC**

(74) Agent and/or Address for Service:
Barker Brettell LLP
100 Hagley Road, Edgbaston, BIRMINGHAM,
B16 8QQ, United Kingdom

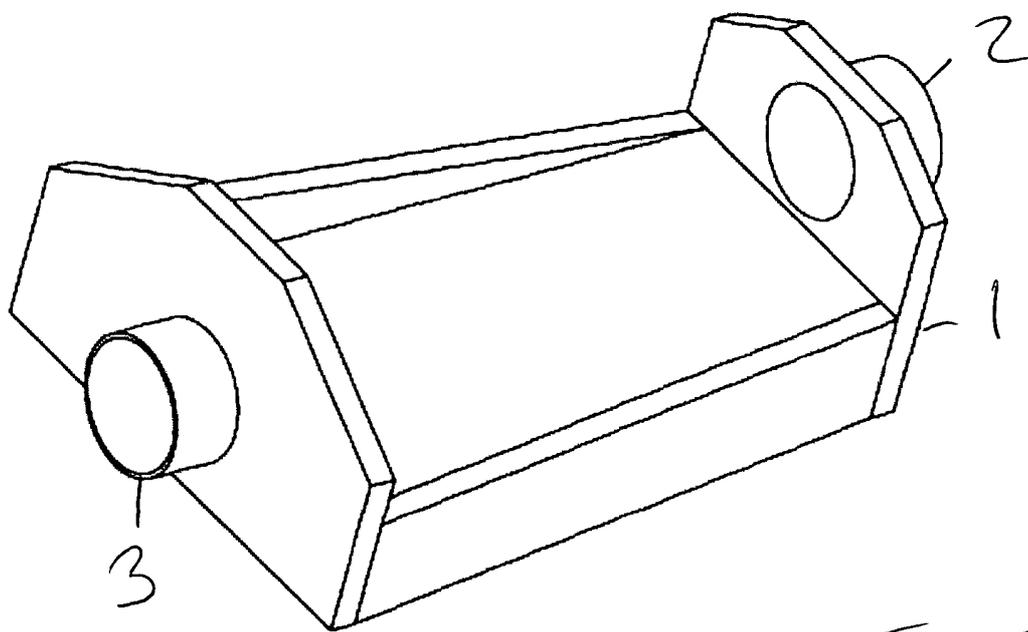
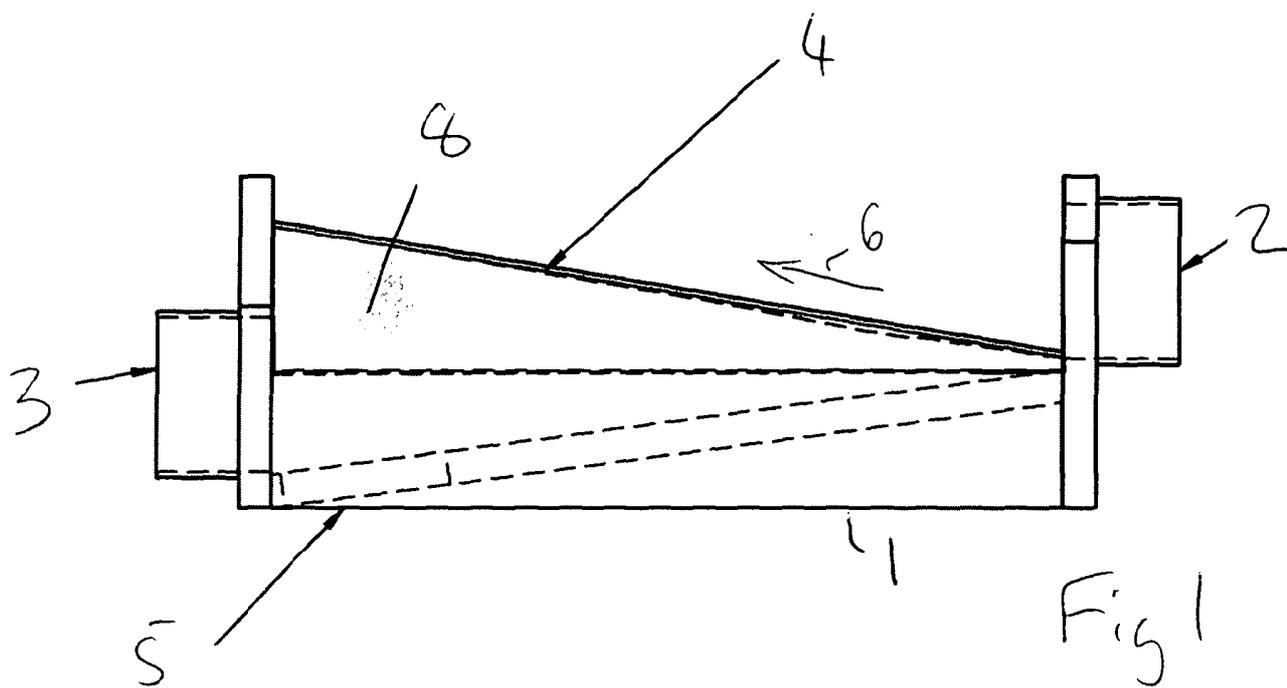
(54) Title of the Invention: **Filter apparatus**
Abstract Title: **Filter apparatus**

(57) A filter apparatus comprising a housing (1) having an inlet (2) for liquid such as rainwater and an outlet (3, 5) for liquid, the inlet (2) and the outlet (3, 5) being horizontally spaced from one another, and a filter element (4) supported by the housing (1) so that the horizontal extent of the filter outlet (4) is from the inlet (2) to the outlet (3,5), so as to filter liquid such as rainwater passing from the inlet (2) to the outlet (3, 5). The filter element (4) is positioned such that, when flowing liquid is introduced to the inlet (2), the kinetic energy of the liquid forces the liquid to flow upwards over the filter element (4) before passing through the filter element to the outlet. Typically, the filter element (4) is shaped so as to descend when moving laterally towards at least one lateral edge (11, Fig 3) of the filter element (4) in the use orientation.

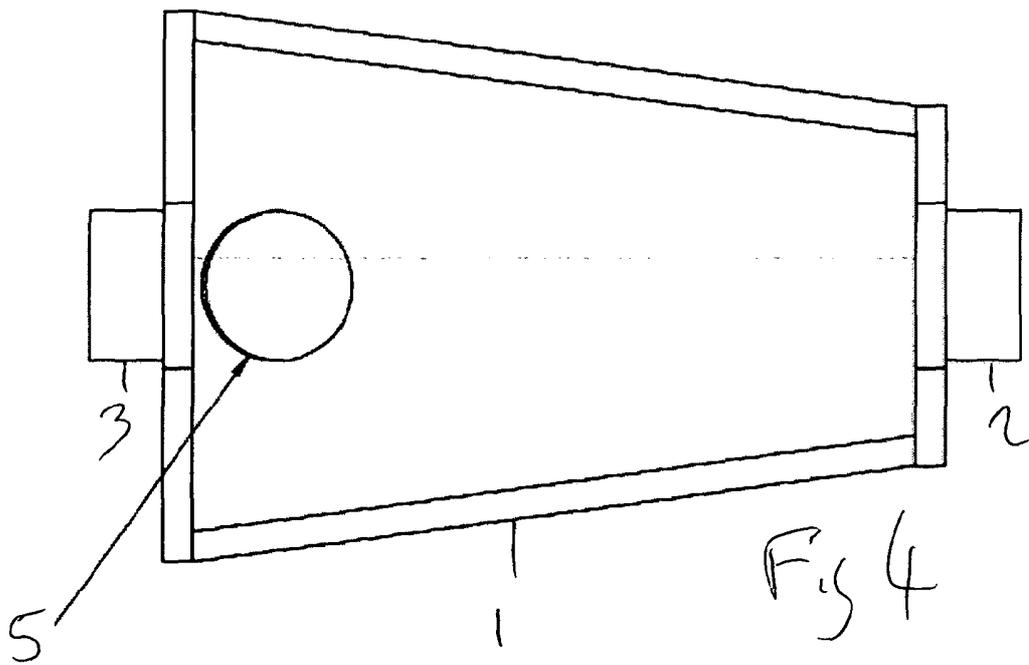
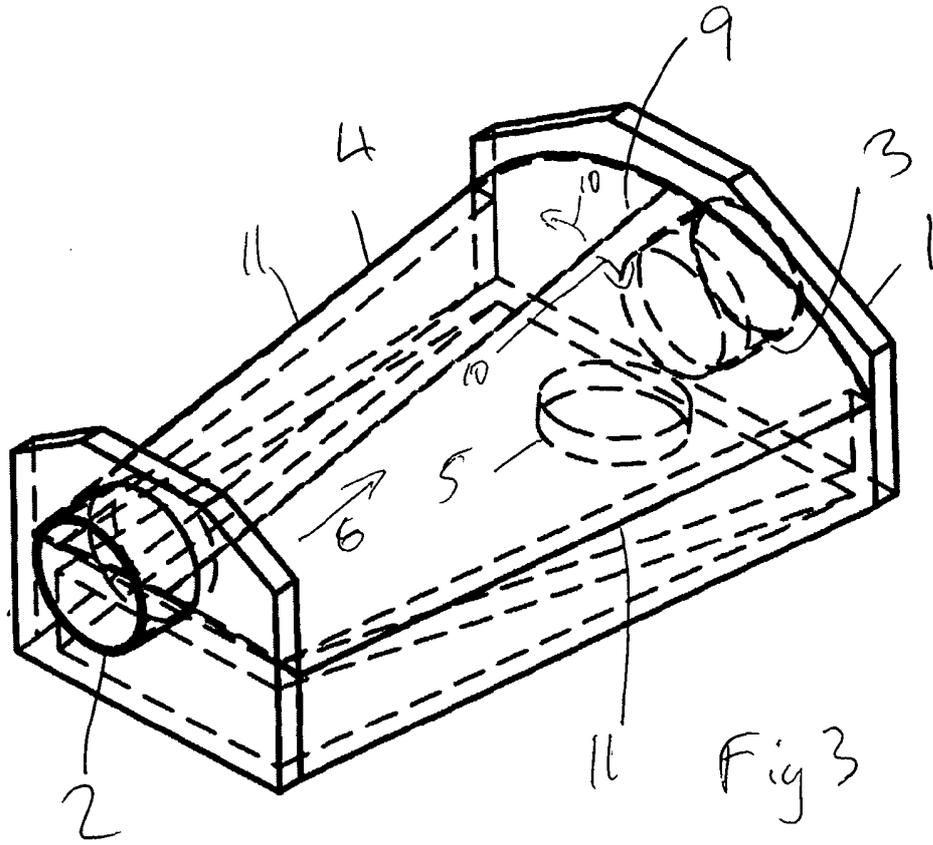


GB 2469017 A

113



2 / 3



3/3

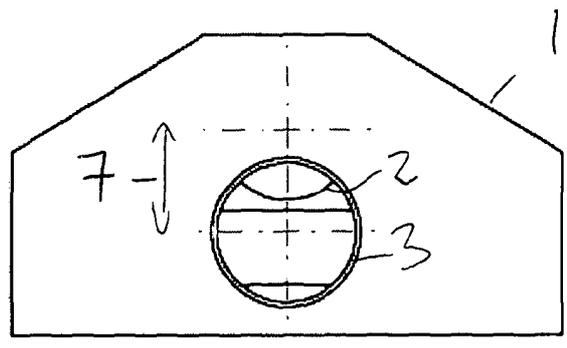


Fig 5

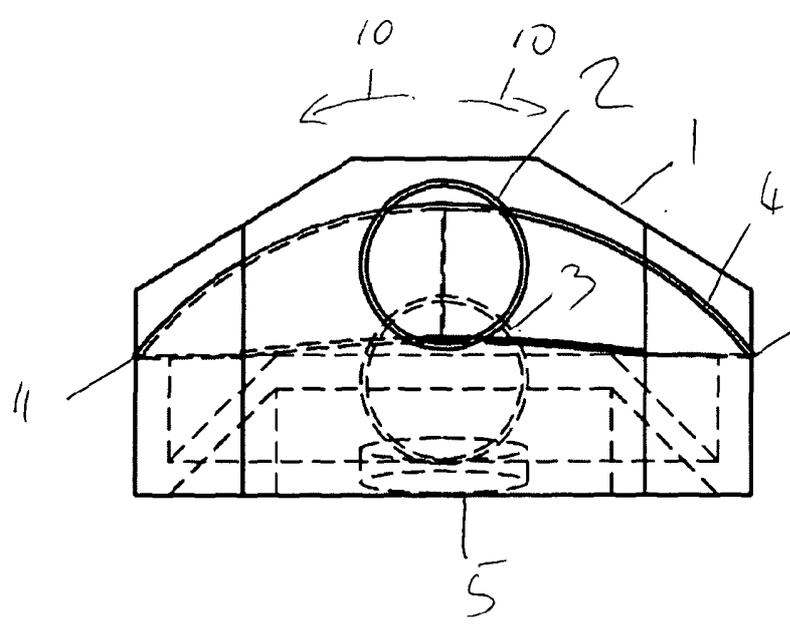


Fig 6.

FILTER APPARATUS

This invention relates to a filter apparatus, such as may typically be used for filtering rainwater.

5

It is desirable to filter rainwater collected from the roofs of buildings so as to remove solid matter before reuse of the water. As demand for water increases, and the availability of water in some areas is less than required, the need to make efficient use of all sources of water increases.

10 It has been appreciated that rainfall collected from the roofs of buildings can be used for tasks that do not require potable water, such as watering gardens, flushing toilets or some industrial uses, with only filtering of the water required.

15 However, the amount of rainfall collected from a roof can vary wildly, as rainfall tends to happen in short bursts of varying strength. Engineering a system to cope with the maximum expected peak rainfall can lead to a system that is over-engineered (and hence is unnecessarily expensive) for the vast majority of the time that it is operation. Such a system is
20 discussed in European Patent Application publication no EP 0 928 861, which describes a filter apparatus with a curved, horizontal strainer body.

According to a first aspect of the invention, there is provided a filter apparatus comprising a housing having an inlet for liquid and an outlet for
25 liquid, the inlet and the outlet being horizontally spaced from one another, and a filter element supported by the housing so that the horizontal extent of the filter outlet is from the inlet to the outlet, so as to filter liquid passing from the inlet to the outlet, in which the filter element is positioned such that, when flowing liquid is introduced to the
30 inlet, the kinetic energy of the liquid forces the liquid to flow upwards

over the filter element before passing through the filter element to the outlet.

5 By arranging the filter element so that liquid flows upwards under the action of the kinetic energy of the flowing liquid, the invention allows for more of the filter to be used in higher flow rates. The apparatus makes use of the inertia of the fluid flow to reduce the height needed to perform the filtration of a liquid.

10 Also, the upwards movement dissipates some of the kinetic energy (by converting it to potential energy) thus slowing the flow of the liquid before it passes through the filter element. Under low flow conditions, this means that only a portion of the filter element need be used; this keeps the localised pressure differential high and thus improves the flow
15 of liquid through the filter element whilst leaving particulate matter behind.

In the preferred embodiment the liquid is water, typically rainwater. Thus, the filter apparatus is particular useful as it allows for the large
20 variation in rainfall rates inherent in collection rainwater.

When the filter apparatus is in a use orientation, the filter element may be orientated such that it extends upwards as it extends in a longitudinal directional horizontally away from the inlet to the outlet. The use
25 orientation may be that orientation in which the device is used when suitable supply and output pipes are connected to the inlet and outlet respectively. In the use orientation, at least one of the inlet and the outlet may be positioned for horizontal liquid flow therethrough.

30 Whilst the filter element may be arranged to extend generally upwards as it extends longitudinally, the filter element may be shaped so as to

descend when moving laterally towards at least one lateral edge of the filter element; typically it will do so towards two opposing lateral edges. As such, the filter assembly may be arranged so that whilst filtered liquid passes through the filter element in use, unfiltered can leave the filter assembly over the or each lateral edge. This allows for the particulate matter suspended in the liquid to be carried off the filter element by the unfiltered liquid. The unfiltered liquid will be encouraged to drain off to the or each lateral edge by the shape of the filter element descending towards the or each lateral edge, thus defining a filter element that is potentially self-cleaning. Typically, the filter assembly will descend towards two lateral edges from a high point or high line, which may be the longitudinal centreline of the filter element.

The filter element, in the use orientation, may therefore have a generally ascending cross section taken along the longitudinal direction (from inlet to outlet), but an at least partially descending, typically arch-shaped cross section taken across a lateral direction. This means that as liquid is introduced to the inlet, its kinetic energy will force it up the filter element in the longitudinal direction. Some of the liquid will filter through the filter element, whereas the remainder will flush the residue off the filter element to the or each lateral side. The descending parts of the lateral cross section will also mean that a greater lateral width of the filter element will be used at higher flow rates, thus increasing more the area of filter element available at higher flow rates.

25

The cross section of the filter element along the longitudinal direction may be linear, with an angle to the horizontal in the use orientation of at least 5 and less than 30 degrees, and preferably around 15 degrees. However, curved longitudinal cross sections are not excluded.

30

This arrangement of the apparatus can reduce the necessary vertical profile of the filter apparatus. As such, the inlet may have a diameter, and the outlet may be positioned not more than one inlet diameter lower than the inlet, or even not more than half an inlet diameter below the outlet. Thus, a much flatter profile is possible, because the liquid will have been forced to flow upwards over the filter, making better use of both the vertical profile of the device and of its horizontal extent.

The housing may comprise a channel adjacent to each lateral edge, arranged so as to collect any water that runs off the filter element. This unfiltered water will be carrying an increased concentration of particulate material as compared with that at the inlet, and so can be disposed of as dirty rainwater, perhaps by being discharged into a sewer or other watercourse, or by channelling it to a suitable soakaway.

15

According to a second aspect of the invention, there is provided a method of filtering a liquid, comprising introducing the liquid at the inlet of the filter apparatus of the first aspect of the invention so as to flow therethrough, in which the filter apparatus is positioned such that the liquid flows upwards over the filter element as it flows from the inlet to the outlet.

20

Typically, the filter apparatus will be in the use orientation.

There now follows, by way of example only, an embodiment of the invention, described with reference to the accompanying drawings, in which:

Figure 1 shows a filter apparatus according to a first aspect of the invention in a central lateral vertical cross section;

30

Figure 2 shows a perspective view of the filter apparatus of Figure 1, with its filter element removed;

5 **Figure 3** shows a perspective view of the filter assembly of Figure 1 with the filter element installed, from the opposite end to that of Figure 2;

Figure 4 shows an underneath plan view of the filter apparatus of Figure 1;

10

Figure 5 shows an end elevation of the filter apparatus of Figure 1; and

15 **Figure 6** shows the same view as Figure 5, with some internal detail shown.

The accompanying Figures show a filter apparatus for use in filtering rainwater, according to an embodiment of the invention. The apparatus comprises a housing 1 having an inlet 2 formed in one horizontal end of the housing. The housing also has two possible outlets; a first outlet 3, 20 formed in the opposite horizontal end of the housing 1 to the inlet 2 and generally in a parallel plane to the inlet 2 and a second outlet 5, which is in the floor of the housing, in a plane perpendicular to that of the inlet 2, but still at the far end of the housing from the inlet 2.

25

The first outlet 3 is typically used where the filtered water is to be passed through a pipe to another location, whereas the second outlet 5 is typically used where the filtered water is to be passed into a tank (not shown) below the filter apparatus. Only one outlet would generally be 30 used at a time; the other would be blanked off.

A filter element 4, being formed of metal or plastic gauze (shown schematically as a patch 8 in Figure 1 although the entire filter element would generally be of the gauze material), is mounted in the housing between the inlet 2 and the outlets 3, 5. Alternatively, the filter element
5 could be formed of a shaped, perforated sheet of metal or plastic.

In use, the filter apparatus will normally be orientated in the use orientation shown in Figure 1 of the accompanying drawings. It is to be noted that the filter element 4 generally rises from below the inlet 2 to
10 well above the first outlet 3. This means that, with flowing water introduced at the inlet 2 (for example, by connecting the downpipe from a roof gutter thereto), the kinetic energy of the water will force the water upwards and along the filter element 4, in the direction of arrow 6. The
15 faster the water introduced at the inlet 2 flows, the further up the filter element 4 the water will travel.

Accordingly, the apparatus uses the energy from the flowing water to reduce the height needed to allow gravity to perform the filtration of the fluid. In low flow situations, the device allows the water to flow only
20 over a small portion of the fluid, thus keeping the local pressure differential high and achieving reliable filtration. At higher flows, more of the filter is used, and the upwards motion means that the velocity of the water further from the inlet will be reduced.

25 Once the rain water has flowed through the filter element, thus removing particulate matter therefrom, the filtered rainwater drains through the housing 1 into the first 3 or second 5 outlets, for onward transmission or use.

30 Whilst the filter element 4 ascends along its longitudinal cross-section shown in Figure 1, its lateral cross section (shown in Figure 6) is curved

in an arch shape. This means that, in addition to travelling upwards as shown by arrow 6 as the rainwater flows longitudinally, the rainwater will spread laterally to either side of centreline 9 as shown by arrows 10; the greater the flow of rainwater, the more the flow will spread laterally.

5

Once the flow reaches either of the lateral edges 11, it will flow over that edge, taking its entrained particulate matter with it. Thus, heavier flows that reach the edges will flush particulate matter filtered out of the rainwater over the edges 11 of the housing. The housing 1 can be provided with a channel (not shown) at either side to collect water which has fallen over the lateral edges; this can be used to transport the "dirty" water, carrying an increased concentration of the particulate matter, to a suitable disposal site, such as a sewer, watercourse, or soakaway. Alternatively, if the filter assembly is buried, the dirty water can simply be allowed to soak away into the surrounding ground.

10
15

The filter element can be coated with a non-stick coating, such as polytetrafluoroethylene (PTFE, commonly known as Teflon (RTM)). This assists in the avoidance of build ups of contaminating matter. The filter element is removable, as shown in Figure 2 of the accompanying drawings, for cleaning. The housing may be provided with a removable lid (not shown) to prevent matter falling on the filter element and clogging it. This can be removed to allow for cleaning of the filter element.

20
25

Because of the use of the conversion of kinetic energy into the potential energy of the water in order to assist with filtering, the vertical profile of the device can be reduced. As such, it is to be noted from Figure 5 of the accompanying drawings that the first outlet 3 is displaced by the distance shown as 7 in that Figure. This distance is only half the diameter of the

30

8

inlet 2. The second outlet 5 is only one inlet diameter below the inlet.
Thus, the vertical profile of the filter is low.

CLAIMS

1. A filter apparatus comprising a housing having an inlet for liquid and an outlet for liquid, the inlet and the outlet being horizontally spaced
5 from one another, and a filter element supported by the housing so that the horizontal extent of the filter outlet is from the inlet to the outlet, so as to filter liquid passing from the inlet to the outlet, in which the filter element is positioned such that, when flowing liquid is introduced to the inlet, the kinetic energy of the liquid forces the liquid to flow upwards
10 over the filter element before passing through the filter element to the outlet.
2. The filter apparatus of claim 1, in which more of the filter is used to filter liquid at higher liquid flow rates than at lower flow rates.
15
3. The filter apparatus of claim 1 or claim 2, for use in filtering water, typically rainwater.
4. The filter apparatus of any preceding claim, in which, with the
20 filter apparatus in a use orientation, the filter element is orientated such that it extends upwards as it extends in a longitudinal directional horizontally away from the inlet to the outlet.
5. The filter apparatus of any preceding claim, in which the filter
25 element is shaped so as to descend when moving laterally towards at least one lateral edge of the filter element in the use orientation.
6. The filter apparatus of claim 5, in which the filter assembly is arranged so that whilst filtered liquid passes through the filter element in
30 use, unfiltered liquid can leave the filter assembly over the or each lateral edge.

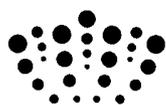
7. The filter apparatus of any preceding claim, in which the filter element, in the use orientation, has a generally ascending cross section taken along a longitudinal direction from inlet to outlet, but an at least
5 partially descending, typically arch-shaped cross section taken across a lateral direction.

8. The filter apparatus of any preceding claim, in which the inlet has a diameter, and the outlet is positioned not more than one inlet diameter
10 lower than the inlet, or typically not more than half an inlet diameter below the outlet.

9. A method of filtering a liquid, comprising introducing the liquid at the inlet of the filter apparatus of the first aspect of the invention so as to
15 flow therethrough, in which the filter apparatus is positioned such that the liquid flows upwards over the filter element as it flows from the inlet to the outlet.

10. The method of claim 9, in which the filter apparatus is in the use
20 orientation.

11. A filter apparatus of the kind set forth substantially as described herein with reference to and as illustrated in the accompanying drawings.



Application No: GB0903979.3

Examiner: Beverley Lloyd

Claims searched: 1 - 11

Date of search: 6 July 2009

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1 - 4, 8 - 10	EP0358952 A1 (ROMAG) See Fig 1 & WPI English Abstract Accession No. 1990-084837 [12] at least
X	1 - 3 & 8 - 10	DE10213816 A1 (OTTO) See Fig 5 inlet 25, outlet 27 & WPI English Abstract Accession No. 2003-878964 [82] at least

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

B1D

Worldwide search of patent documents classified in the following areas of the IPC

B01D; C02F; E03B; E04D

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
B01D	0029/05	01/01/2006
B01D	0029/03	01/01/2006
B01D	0035/02	01/01/2006
B01D	0035/22	01/01/2006
C02F	0001/00	01/01/2006
E03B	0003/02	01/01/2006
E04D	0013/08	01/01/2006