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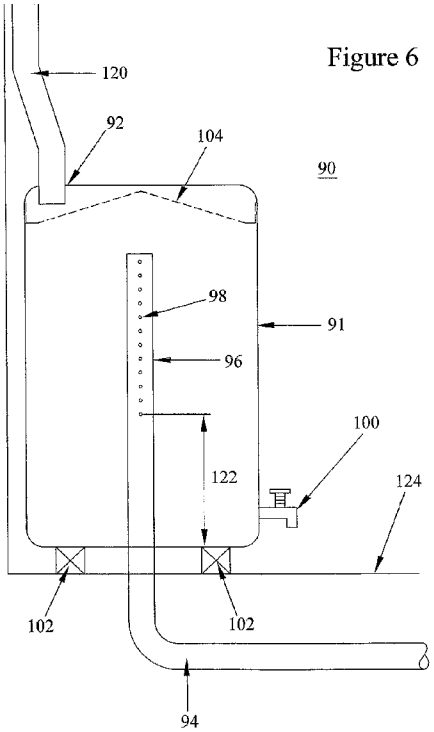
(54) **Title**: DRAINAGE ATTENUATING DEVICE

Figure 6



(57) **Abstract**: A drainage attenuating device comprising: a storage container having an inlet and an outlet and adapted to collect and store rainwater entering the storage container via the inlet; and flow restricting means adapted to restrict the flow of rainwater from the storage container towards a sewer system via the outlet.

Drainage Attenuating Device

The present invention relates generally to drainage systems. In particular, but not exclusively, the invention relates to an improved drainage system having means for rainwater storage and/or pollution control or at least remediation.

With increasing urbanisation and coverage of permeable ground with hard, impermeable surfaces, the problem of disposal of precipitation, especially rainwater, is increasingly onerous. Whereas, in the natural permeable state, the ground absorbs precipitation (primarily rainwater) through the entirety of its surface, hard, impermeable surfaces introduced by buildings cause diversion of the rainwater to localised collection points from where they are discharged into the public drainage network.

The rate of flow of water diverted through a single outlet can be very considerable, especially during storms when the high flow rates caused by heavy rainfall can exceed the design flow rates of the drainage networks. This can lead to overflows, surcharging and, in the worst case, flooding.

It has always been recognised that building developments change the pre-existing drainage patterns, but more recently it has been realised that they also result in the introduction of pollutants, especially hydrocarbons and heavy metals, which gradually accumulate and become a problem downstream where the drainage network exits into aquifers or watercourses. The need to protect water quality during urbanisation of catchment areas is matched by the equal, but to some extent more urgent, need to take steps at least to reduce the effect of pollution in existing urban areas where little or no attempt has previously been made to address the problem of pollution from water draining, for example, from private driveways and pathways of domestic properties.

Collectively, the area covered by such private driveways and pathways is much greater in any given urban area than the area of public car parks. Legislation has been in place for some time requiring measures to be taken to reduce the pollution in run-off waters from public car parks and areas where vehicles are likely to give rise to pollution, but domestic

premises represent a much bigger pollution source, and consequently, a much bigger problem. The difficulty in addressing this problem, however, is that whereas a single measure can be taken to reduce pollution from a public car-park, a plurality of separate individual arrangements have to be made for each separate domestic premises, and the shape and configuration of each individual area, as well as its nature, vary from property to property so that it is very difficult to arrive at a single solution which meets all requirements.

It is desirable to provide a drainage system, or specific units for incorporation into such a drainage system, in which the problem of pollution from driveways and pathways, as well as car-parking areas on domestic premises, can at least be mitigated if not entirely solved.

Another problem of increasing urbanisation, hinted at above with reference to the overflow and flooding caused during periods of heavy rainfall, lies in the fact that a major problem encountered by public drainage networks is that of coping with peak flows which, by their very nature, occur only occasionally. It is not economically viable to over-engineer all drainage networks so that they have sufficient capacity to cope fully with a peak flow which may be anticipated to occur only once every few decades or even the larger peaks which are expected, say, once every fifty or hundred years, and, consequently, alternative means by which the problem of peak flow can be addressed are needed.

It is desirable to provide means for controlling or limiting the rate of flow of drainage water into the public drainage network from each individual site containing buildings. It is desirable to provide means which can be introduced during construction of the building or retro-fitted to existing buildings.

A further problem which is encountered frequently, especially in individual buildings which are constructed on a speculative and one-off basis by different builders, is that of misconnection or so-called cross-connection of foul water drains and clean water drains. Heavily biologically contaminated water from toilets, and household drain water contaminated with detergents and other cosmetic preparations are intended to be directed via a separate sewage network to sewage farms where proper biological and

physical treatment of the contaminating material can be undertaken. Sometimes clean water run-off is allowed to enter such foul water drainage systems as a practical or economy measure, to avoid the need for two separate pipes, but in this case the "combined" effluent is still sent to a sewage water treatment plant. In many cases these two drainage systems are maintained entirely separate from one another. However, because occasionally foul water and clean water is allowed to mix, it occasionally happens, sometimes inadvertently and, unfortunately, sometimes deliberately, that foul water pipe work is connected into a clean water drainage system resulting in contamination of clean water which is usually discharged straight into a natural watercourse without treatment, thus resulting in contamination of the watercourse.

It is desirable to provide means by which the problem of cross-connection or misconnection of foul water drainage systems can be almost entirely avoided by ensuring that, should any misconnection take place, the contamination will be limited to the curtilage of the building concerned, and will not enter the public drainage network.

According to a first aspect of the present invention there is provided a drainage attenuating device comprising:

a storage container having an inlet and an outlet and adapted to collect and store rainwater entering the storage container via the inlet; and

flow restricting means adapted to restrict the flow of rainwater from the storage container towards a sewer system via the outlet.

The storage container may be adapted to temporarily store the rainwater. Rainwater may be stored only for the time period required for the rainwater to restrictedly flow from the storage container.

Alternatively, the storage container may be adapted to permanently store a first volume of the rainwater and to temporarily store a second volume of the rainwater in excess of the first volume.

The flow restricting means may comprise a riser pipe provided within the storage container. The riser pipe may be directly connected to the outlet. The riser pipe may include a plurality of apertures to allow rainwater to flow into the riser pipe. Apertures may be provided at a plurality of heights of the riser pipe.

The diameter of each aperture may be substantially less than the diameter of the outlet. The sum of the diameters of each aperture may be less than the diameter of the outlet. Alternatively, the sum of the diameters of the majority of apertures may be less than the diameter of the outlet.

Alternatively or in addition, the riser pipe may have a diameter which is less than the diameter of the outlet.

Alternatively, the flow restricting means may comprise an orifice plate or perforated plate or the like provided at the outlet.

The term "flow restricting means" is intended to cover any means which reduces but not prevents the flow of rainwater from the storage container towards the sewer system. It does not include taps, stop valves and the like. However, the drainage attenuating device may additionally include a stop valve for selectively allowing or preventing the flow of rainwater from the storage container.

The stop valve may be provided at or near a base portion of the storage container to allow the flow of rainwater to the exterior of the storage container.

Alternatively or in addition, a stop valve may be provided at the outlet for selectively allowing or preventing the flow of rainwater from the storage container via the outlet.

The outlet may be directly connected to a sewer system. The sewer system may be a public sewer system. Alternatively, the outlet may be connected to a treatment chamber.

The base of the storage container may be located at or above ground level. Alternatively, the base of the storage container may be located below ground level.

The drainage attenuating device may include a filter for filtering rainwater entering the storage container. The filter may comprise a screen for preventing debris and the like from entering the storage container.

According to a second aspect of the present invention there is provided a drainage system suitable for a single drainage source (by which is meant an individual building or small group of buildings but not necessarily domestic buildings) having means for encouraging remediation of certain pollutants whereby to avoid deterioration of water quality, and means for absorbing peak inflow to the system from the source whereby to avoid surcharging or overloading a downstream drainage network.

The means for encouraging remediation of certain pollutants may comprise, for example, screening and/or filtering means for entrapment of pollutant particles. Other pollutant-remediation or pollution-control means may, of course, be employed in this system.

Where screening and/or filtering means are provided these are preferably removable for cleaning purposes.

In one embodiment of the present invention both the screening and filtration means are provided in the form of a combined screening and filtration unit. Such a unit may, therefore, be constructed and sold for introduction into drainage systems formed in accordance with the present invention. As will be explained below, the present invention also comprehends a connection unit suitable for use in such drainage systems, and preferably incorporates screening and filtration means as described above.

A major component of a drainage system of this type comprises temporary storage means having a sufficient capacity to accommodate peak flows anticipated for a given time period. Such temporary storage means may be in the form of a subterranean layer of coarse particulate material. Such material may be non-friable, frost resistant and, in some cases,

resistant to the compressive forces of vehicular traffic which may pass over it. Crushed rock, hardcore, and stones of suitable composition are all examples of materials which may be used for this purpose, but it is also possible to use specially constructed apertured boxes or "crates" of durable strong material such as injection moulded plastics.

The temporary storage means may be provided with an impermeable boundary layer, for example in the form of an impermeable membrane underlying the subterranean layer of coarse particulate material. An impermeable boundary may, however, be provided by natural means, for example by a clay layer.

The connector unit leading to a downstream drainage network may have an outlet of calibrated dimension such as to allow a rate of flow of water from the temporary storage means no greater than a predetermined maximum value whereby to avoid overloading the downstream drainage network.

Additionally, or alternatively, the temporary storage means may be provided with a pump by means of which water may be extracted from the storage means, for example for use in washing, garden watering or the like. Indeed, in this case the water storage means may be relatively long-term although it remains "temporary" in the sense that it has a surplus capacity to accommodate fluctuations in flow rate.

The temporary storage means and/or connector unit may further have an outlet to the sub-grade (which may be additional to or alternative to the pump and/or outlet leading to the drainage network) whereby to allow infiltration of water into the surrounding ground. In this connection, the terms sub-base and sub-grade will be understood to mean, in the case of the former, a layer of material underlying a surface layer of any form, which may be permeable or impermeable, and, in the case of the latter, the underlying basic material of the ground onto which the sub-base is laid. The sub-grade may be permeable or impermeable, and may be composed of any naturally occurring materials, including rock, shale, clay etc.

One convenient material for use as the filtration medium is a so-called geotextile. Geotextiles are netting-like mesh materials made from a plastics or other material which are highly resistant to biodegradation such that it remains inviolate for extended periods, or even indefinitely, when located underground.

In order to accommodate the requirement for sufficient capacity to deal with storm water flow rates the screening and filtration unit may incorporate a weir to allow overflow of water directly into the drainage network means at times of excessively high flow rates.

Upon forming a drainage system of the present invention the temporary storage means may be overlaid by an impermeable surface such as a path or driveway, or it may be laid alongside a path or driveway or located under flower beds or lawns. These latter arrangements are particularly appropriate for retro-fitting a drainage system in accordance with the present invention to existing buildings, whereas it may be particularly appropriate to locate the temporary storage means under a driveway in a building under construction.

The present invention also comprehends a connector unit for a drainage system of the type having temporary storage means for holding a volume of drained water at least during periods of high flow rates, the temporary storage means and/or the connector unit having a calibrated outlet whereby to limit or restrict the rate at which water is delivered to a downstream drainage network to a predetermined maximum value regardless of the inflow rate, the connector unit having means for passing potentially polluted water through a filter or screen with a dwell time sufficient to encourage bioremediation thereof, and means by which unpolluted water arriving at the connector can be passed forward to the drainage network. An outlet to allow drainage directly into the ground at a controlled rate may also be provided.

A connector unit for a drainage system having temporary storage means for holding a volume of drained water at least during periods of high flow rate may also comprise an impermeable outer chamber having an inlet opening and an outlet opening and housing a filter through which water flowing in from the temporary storage means is passed, and a coarse screen between this opening and the filter.

In use, incoming water may pass through the screen, which retains any layer of particles, grit, coarse debris, leaves and the like, and then passes through the filter. It is known that many pollutants will be attached to the coarse material retained in the screen, and many more entrapped by the finer filter. This entrapment causes the pollutants to remain in place for an extended period of time during which biological action may occur to cause remediation of these, especially the hydrocarbons. The temporary storage means, especially if formed of crushed rock or the like, may also exert a remedial action by providing interstices, wells and cavities which encourage the growth of bacteria and enhances the bioremediation effect.

Valve means or the like may be provided to isolate the drainage system from the public network if desired.

Various embodiments of the present invention will now be more particularly described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a typical domestic house plot showing a house and garage in front and rear gardens;

Figure 2 is a sectional view on the line II-II of Figure 1 showing a first embodiment of a drainage system in accordance with the present invention;

Figure 3 is a sectional view on an enlarged scale of a treatment and flow control unit suitable for use in the drainage unit of Figure 2;

Figure 4 is a sectional view on the line IV-IV of figure 3;

Figure 5 is a sectional view, similar to that of figure 2, illustrating an alternative embodiment of the invention;

Figure 6 is a sectional view illustrating another alternative embodiment of the invention; and

Figure 7 is a sectional view illustrating another alternative embodiment of the invention.

Referring first to Figures 1 and 2, there is shown in plan form a domestic site generally indicated 11 having a house 12 located between a front garden 13 and a rear garden 14 the latter of which has a patio 15 and a garage 16, with a drive 17 running alongside the front garden. The site 11 fronts onto a roadway 18, from which it is separated by a footpath 19.

A main foul water sewer 20 runs under the roadway 18 alongside the footpath 19 and receives foul drainage from the house 12 via a drainpipe 21 (all subterranean elements are shown in broken outline). Parallel to the foul water sewer pipe 20 is a clean water drainpipe 22 which receives all the surface water run-off from the site in a manner which will be described in more detail below. Surface water run-off is divided into two main categories, namely that for which the catchment area comprises the roofs of the house 12 and garage 16, and that for which the catchment area is the drive 17.

Where hard surfaces such as the garage driveway 17 are concerned, which may be polluted with hydrocarbons or other pollutants consequent of the presence of a motor vehicle, the run-off water is directed by a suitable fall across the driveway to a lateral gully 23 along which it flows to a grating 24 which leads to an underground control and treatment chamber generally indicated 25, which will be described in more detail below.

Water from the roofs of the buildings flows via gutters and downpipes (not shown in Figure 1) into underground drains 42, 43 which lead to a temporary storage reservoir generally indicated 26 (see Figure 2) which is formed as a subterranean drainage cavity, in this case a trench, lined with an impermeable membrane 27 and which is filled with lumps of an irregular particulate material 28, in this case crushed rock, which leaves a proportion of the total volume as void space for accommodating water within the reservoir.

Water from the roofs of the buildings 12, 16 can enter the temporary storage reservoir 26 either directly, through the drains 42, 43, or as shown in Figure 2, via a drainage attenuating device or rainwater butt 52. Clean rainwater from the roof of the building 16 is first collected in the butt 52 via the drainpipe 50 until it is full. A tap 73 provides for simple access to the water contained therein for washing vehicles and/or watering gardens or the like. When the butt 52 is full the overflow pipe 53 conveys water, via a grating 75, to the

underground drainpipe 43 leading to the temporary storage reservoir 26, where it gradually collects in the voids between the stones.

In an alternative embodiment, a drainage attenuating device 90 replaces the water butt 52 and this is shown in Figure 6. The device 90 comprises a storage container 91 which has an inlet 92 which receives the rainwater downpipe 120 of the building. The device 90 also has an outlet 94 connected to a sewer system.

Flow restricting means is provided to restrict the flow of rainwater from the storage container 91 to the sewer system. This is in the form of a riser pipe 96 located within the storage container 91 and directly connected to the outlet 94. The riser pipe 96 includes a number of apertures 98 which allow rainwater to flow into the riser pipe 96. These apertures are provided at discrete heights of the riser pipe 96.

Each aperture 98 has a diameter which is substantially less than the diameter of the outlet 94. Indeed, even the sum of all the diameters of the apertures 98 is less than the diameter of the outlet.

The storage container 91 collects and stores rainwater which enters the storage container 91 via the inlet. The volume 122 of water below the level of the lowest apertures is permanently stored as it cannot enter the riser pipe 96 and drain away. A stop valve 100 is provided near the base of the storage container 91. This water can be used such as for watering the garden or cleaning a car.

Above this level, rainwater is stored only for the time period required for the rainwater to flow (at a restricted rate) from the storage container 91.

In use, rainwater from the building roof enters the device 90. The device reduces the likelihood of sewage surcharging by storing a proportion of the rainwater and more gradually passing the rainwater to the sewage system. Only when the water level reaches the top of the riser pipe 96 will the rainwater be passed to the sewer system at substantially the same rate as it enters the device 90.

The device 90 includes a filter in the form of a screen 104 for preventing debris and the like from entering the storage container.

In this embodiment, the storage container 91 is provided on supports 102. Otherwise, the base of the storage container 91 is located at ground level 124. Alternatively, the base of the storage container may be located below ground level.

In an alternative embodiment shown in Figure 7, the storage container 91 is set into the ground within a concrete surround 104. Therefore, the base of the storage container 91 is located below ground level 124. Also, the apertures 98 are provided even at the lowest portion of the riser pipe 96. There is therefore substantially no permanent storage of any water.

Referring again to Figures 1 to 5, water collecting on the driveway 17, on the other hand, which may be polluted with hydrocarbons or heavy metals or the like from a motor vehicle, runs along the gully 23, for which purpose the driveway 17 has a suitable fall to direct the run-off water to the gully 23, and from there enters the collection and treatment chamber 25 through the grating 24. Any entrained detritus of large dimensions, such as leaves or stones, are caught by the grating 24 and can be removed by periodic brushing. Intermediate particles such as coarse silts, loams, grit and broken parts of leaves which have been swept down with the water and which are too small to be caught by the grating 23 will pass through into the collection and treatment chamber 25.

As can be seen in Figure 3, the collection and treatment chamber 25 comprises an impermeable box-like structure buried in the ground adjacent to the end of the temporary storage reservoir 26. A depending partition 29 separates the treatment unit into two chambers 30, 31 each covered by a removable access cover 32, 33 respectively.

The side wall of the unit 25 facing the temporary storage reservoir 26 is pierced by two inlet pipes, a lower or main perforated inlet pipe 34 and an upper or overflow perforated inlet pipe 35. At a level between these two inlet pipes within the chamber 30 is located a

flat, removable geotextile mesh screen 36 held on supports 37 within the chamber 30 in such a way that when the access cover 32 is lifted the user may remove the geotextile mesh filter 36 for cleaning purposes.

The chamber 31 houses an outlet pipe 38 leading to a downstream drainage network, in particular, the clean water drainpipe 22 under the road 18, and has an upstanding perforated inlet section 39 the holes 40 in which define a restricted inlet into the pipe 38 for reasons which will be explained further hereinbelow. Likewise, the narrow space (shown exaggerated in Figure 3) between the bottom edge of the partition 29 and the bottom wall of the impermeable container forming the collection unit 25 acts as a flow restrictor to slow the flow of water from the chamber 30 into the chamber 31, again for reasons which will be explained in more detail below.

At times of light or moderate rainfall, when the flow rate of water is not greater than that which can pass under the partition 29 unobstructed, water entering the temporary storage reservoir 26 directly from the roofs (or through the butt 52) can flow into the drainpipe 22 at an unobstructed rate. Water running off the driveway 17 into the gully 23, however, flows along this gully, through the grating 24 and then via a transfer passage (not shown in Figures 1 to 3) identified 41 in Figure 4, into the upper part of chamber 30 within the treatment unit 25. From there it flows down through the geotextile filter 36 into the lower part of chamber 30, joining the clean water arriving through the pipe 34 from the temporary storage reservoir 26, and passing under the partition 29 into the chamber 31. The lowermost of the holes 40 in the upright limb 39 of the outlet pipe 38 define a level below which water in the chamber 31 will not enter the pipe 38 and, therefore, define a minimum level within the storage reservoir 26. Once water has risen above this level it flows through the openings 40 into the pipe 38 and thus on into the clean water drain 22.

When rainfall is heavy, on the other hand, it enters the temporary storage reservoir 26 at a faster rate than it can escape through the outlet pipe 38 from the treatment unit 25 and will thus gradually rise to occupy the space in the temporary storage reservoir. This can continue to a point where it is nearly filling the temporary storage reservoir 26. Upon reaching this level, however, the water can then flow through the overflow pipe 35 into the

chamber 30 from where it can pass through the geotextile mesh 36 so that any potential pollution due the fact that excess rainfall may also have washed over the driveway 17, can be removed by the filter 36 before it enters the drainpipe 38.

It should be noted that in circumstances where this drainage system is being fitted to an existing property it is not essential for the sub-base defining the temporary storage reservoir 26 to be formed under the driveway 17, this is merely a convenient location for it. The trench may alternatively be located alongside the driveway or at any point under the garden providing a suitable overlying geotextile 42 (see Figure 3) or other support material is provided to prevent the void spaces between the stones in the sub-base 24 from becoming clogged by soil particles or other material entering through its upper surface.

In this way the sub-base of stones acts as a temporary storage reservoir for water arriving at high flow rates during storms. After the storm the water stored in the void spaces can gradually flow out through the flow restrictor defined by the partition 29 and the holes 40 into the clean drain 22 over a period of time at a rate such that overloading of the clean drain is avoided.

Figure 2 also shows an arrangement in which not only the principles of retention of polluting particles by means of a filter membrane and temporary storage of water to limit the flow rate into the main drainage network are provided, but in which there are also means for water harvesting so that clean run-off water can be saved for use by the householder, such as for car washing and garden watering. The drainage system illustrated in Figure 2 is intended to service a domestic dwelling in which there is water run-off from the roofs of the buildings, illustrated here by a drainpipe 50 leading to the water butt 52 from which an overflow pipe 53 leads via the grating 75 and pipe 43 to the sub-base which, as mentioned above, may be composed of broken or crushed void-defining stones. As also shown in Figure 2, the void space can be increased by the use of crates 58 of water-resistant material such as plastics, which support the loads above the sub-base 57 but provide a greater void space than stone. Beneath the sub-base, and joined to it by a vertical passage 59 is a sump 60 for longer term storage of water. The sump 60 contains a

water pump 61 having an outlet pipe 62 leading to a faucet or other water outlet 63 in the garden.

Water draining through the sub-base 57 passes through the passage 59 into the subterranean sump 60 for longer term storage and re-use. The faucet 63 can be located at a point on the property distant from the butt 52 so that two take-off points for clean rainwater are available to the householder. Once the sump 60 is full the temporary storage within the sub-base 57 starts to build up. Because crates 58 are provided, the volume of storage within the overall volume of the sub-base is a greater percentage of the total volume of the chamber than in the case of the use of stone only.

The water temporarily stored within the sub-base 26 can leak away through the outlet restrictor defined by the partition 29 to the clean water drain 22. It will be appreciated that any misconnection of the foul water drainpipe 21 (see Figure 1) to the clean water drainage system other than to the foul water drainage pipe 20 in the public network will result in clogging of the filters and/or of the interstices in the sub-base, resulting in eventual blockage and backing up of the water retained on the premises. Such misconnection thus results in evidence becoming quickly apparent to the householder and remaining a problem for the householder rather than for the authorities in charge of the public drainage network.

Referring now to Figure 5, there is shown an alternative embodiment of the invention with a different configuration of filtering and flow control arrangements. The drainage system of this embodiment has a temporary water reservoir 26 like the previous embodiment, comprising a trench alongside a driveway (not shown) and overlain by soil. The temporary storage reservoir is filled with irregular rock and stone 28 as before, but in this embodiment the water enters the drainage system through a flow-balancing box 55 at the inlet end of the system, which comprises a generally rectangular container 66, typically made of an injection-moulded plastics material having a partition 67 with a lower lip of ledge 68 for retaining a geotextile 69, and an upper lip or ledge 70 for retaining the grating 54.

The container 66 has an inlet connection 71 for receiving the discharge end of the underground drainpipe 53 leading from the roofs of the buildings, perhaps via an arrangement similar to the collection butt described in relation to the previous embodiment (see Figure 4) and a low level outlet pipe 72 leading through the wall of the container 66 into the interior of the temporary storage reservoir 26. Both the inlet pipe 71 and the outlet pipe 72 are spaced from the bottom of the chamber defined by the interior of the flow-balancing box 66 to allow for a small amount of sediment to collect there during periods of low rainfall and therefore relatively light flow rates. The geotextile 69 and the sub-base of stones 28 in the temporary storage reservoir 26 act to trap polluting particles of hydrocarbons, heavy metals and other pollutants, in the same way as described previously in relation to the other embodiments. Periodic cleaning of these is of course necessary. A further geotextile layer 81 is located between the upper surface of the sub-base of stones 28 and the surface layer 67 to prevent the ingress of fine particles which would clog the interstices of the sub-base layer and result in the need for cleaning more frequently.

A high level outlet pipe 73 also passes through the wall of the container 66 to allow an increased flow rate out of the container when this becomes filled with water. As in the previous embodiment potentially polluted water from the driveway enters through the grating 54 and must pass through the geotextile 69 before reaching the lower part of the container 66 and exiting through the outlet pipe 72. Thus, when normal rainfall is experienced the flow-balancing box 66 allows clean water to flow straight through from the drain pipe 53 through the outlet pipe 72 into the temporary storage reservoir 26, from where it passes out through a low level outlet pipe 74 into the interior chamber 76 of an outlet connector box 77. This outlet connector box has an outlet pipe 78 an upstanding part of which has a plurality of apertures 79 the total cross sectional area of which defines the outlet flow cross section from the drainage system as a whole and thus the maximum flow rate which can be delivered to the downstream drainage network such as the public drains.

A removable inspection cover 80 allows for periodic inspection of the interior chamber 76 to check for silting. A high level outlet pipe 75 allows an increased flow rate from the

temporary storage reservoir 26 into the outlet connection box 77 in times of high flow rates.

The drainage system of the present invention and the drainage collector and connecting units described hereinabove thus allow cleansing of polluted water via the filtration and sedimentation arrangements within the drainage system whilst clean run-off water from the roofs of the buildings is not delayed in its transit through the system other than by the flow-restrictor which ensures that the rate of delivery of rainwater to the public network is limited to the predetermined maximum value. Thus the three main problems of pollution, excess discharge and misconnection are all satisfactorily dealt with in one system connected to an individual property.

CLAIMS

1. A drainage attenuating device comprising:

a storage container having an inlet and an outlet and adapted to collect and store rainwater entering the storage container via the inlet; and

flow restricting means adapted to restrict the flow of rainwater from the storage container towards a sewer system via the outlet.

2. A device as claimed in claim 1, wherein the storage container is adapted to temporarily store the rainwater.

3. A device as claimed in claim 1, wherein the storage container is adapted to permanently store a first volume of the rainwater and to temporarily store a second volume of the rainwater in excess of the first volume.

4. A device as claimed in any preceding claim, wherein the flow restricting means comprises a riser pipe provided within the storage container.

5. A device as claimed in claim 4, wherein the riser pipe includes a plurality of apertures to allow rainwater to flow into the riser pipe.

6. A device as claimed in claim 5, wherein the apertures are provided at a plurality of heights of the riser pipe.

7. A device as claimed in claim 5 or 6, wherein the diameter of each aperture is substantially less than the diameter of the outlet.

8. A device as claimed in claim 7, wherein the sum of the diameters of each aperture is less than the diameter of the outlet.

9. A device as claimed in any of claims 1 to 3, wherein the flow restricting means comprises an orifice plate.

10. A device as claimed in any preceding claim, including a stop valve for selectively allowing or preventing the flow of rainwater from the storage container.

11. A device as claimed in any preceding claim, wherein the outlet is directly connected to a sewer system.

12. A device as claimed in claim 11, wherein the sewer system is a public sewer system.

13. A device as claimed in any of claims 1 to 10, wherein the outlet is connected to a treatment chamber.

14. A device as claimed in any preceding claim, wherein the base of the storage container is located at or above ground level.

15. A device as claimed in any of claims 1 to 13, wherein the base of the storage container is located below ground level.

16. A device as claimed in any preceding claim, including a filter for filtering rainwater entering the storage container.

17. A drainage system suitable for a single drainage source, having means for encouraging remediation of certain pollutants and means for absorbing peak inflow to the system from the source whereby to avoid surcharging or overloading a downstream drainage network.

18. A drainage system as claimed in Claim 17, in which the said means for encouraging remediation of certain pollutants comprise screening and/or filtering means for entrapment of pollutant particles.

19. A drainage system as claimed in any of Claims 17 or 18, in which there are provided temporary storage means in the form of a subterranean layer of coarse particulate material.

20. A drainage system as claimed in Claim 19, in which an impermeable membrane underlies the subterranean layer of coarse particulate material.

21. A drainage system as claimed in any of Claims 19 or 20, in which a pump is provided for extracting water from the temporary storage means for re-use.

22. A drainage system as claimed in any of Claims 19 to 21, in which the temporary storage means has an outlet to the sub-grade allowing infiltration of water into the surrounding ground.

23. A drainage system as claimed in any of Claims 17 to 22, including a filter comprising a geotextile.

24. A connector unit for a drainage system having temporary storage means for holding a volume of drained water at least during periods of high flow rates, the connector unit and/or the temporary storage means having a calibrated outlet whereby to limit or restrict the rate at which water is delivered to a downstream drainage network to a predetermined maximum value regardless of inflow rate, the connector unit having means for passing potentially polluted water through a filter or a screen to encourage bioremediation thereof, and means by which unpolluted water arriving at the connector, can be passed forward to the drainage network without passing through the said filter means.

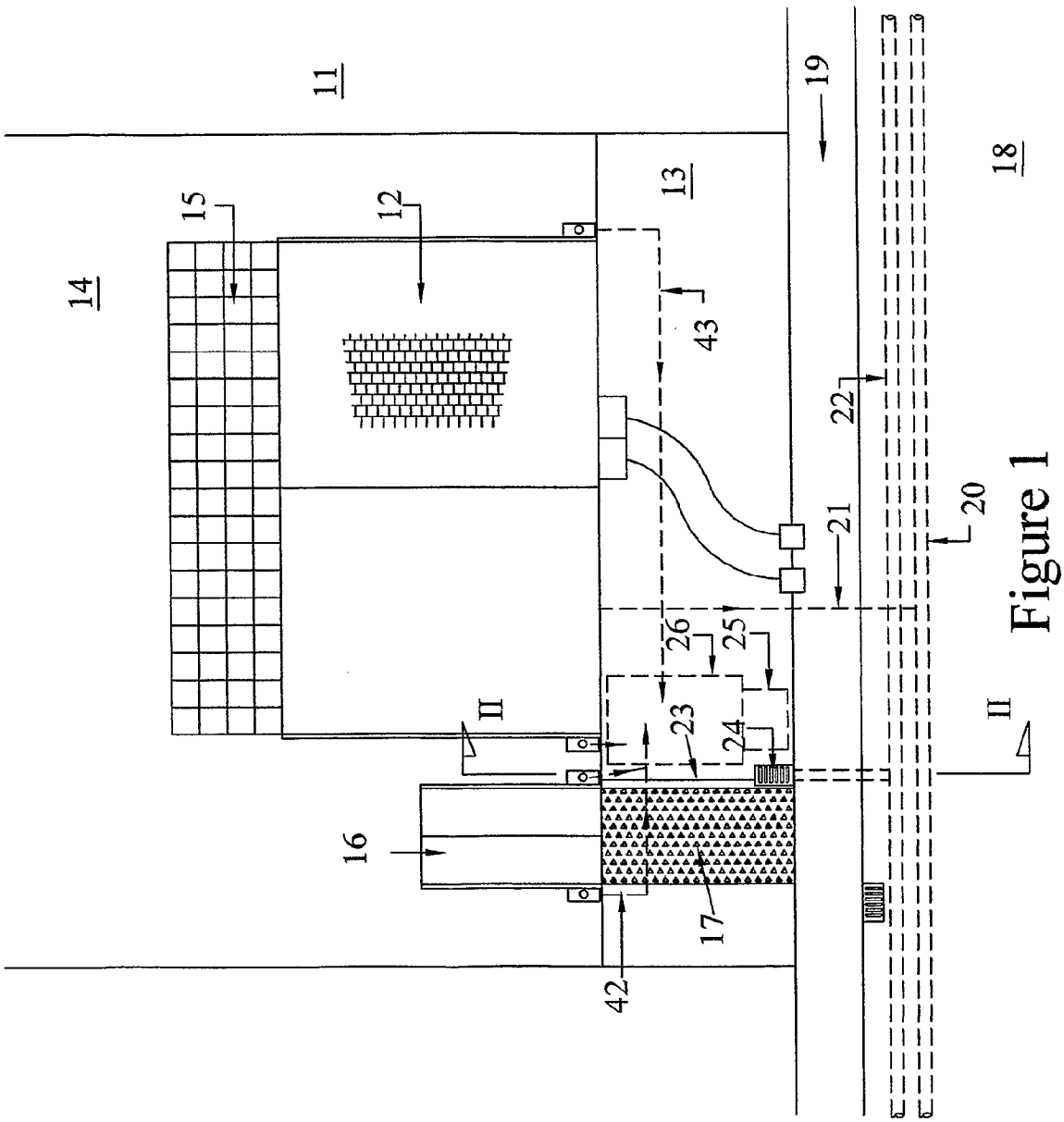


Figure 1

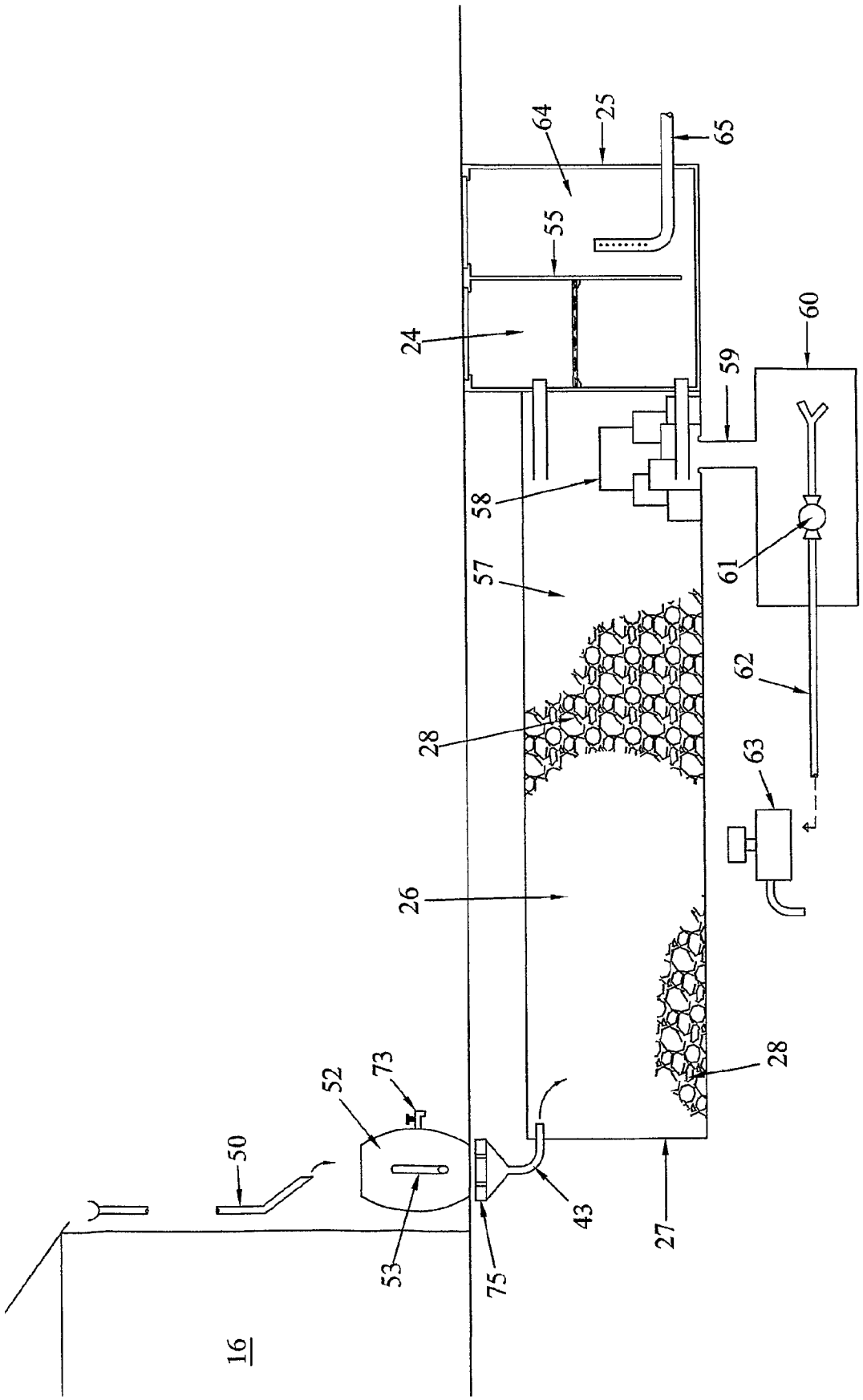


Figure 2

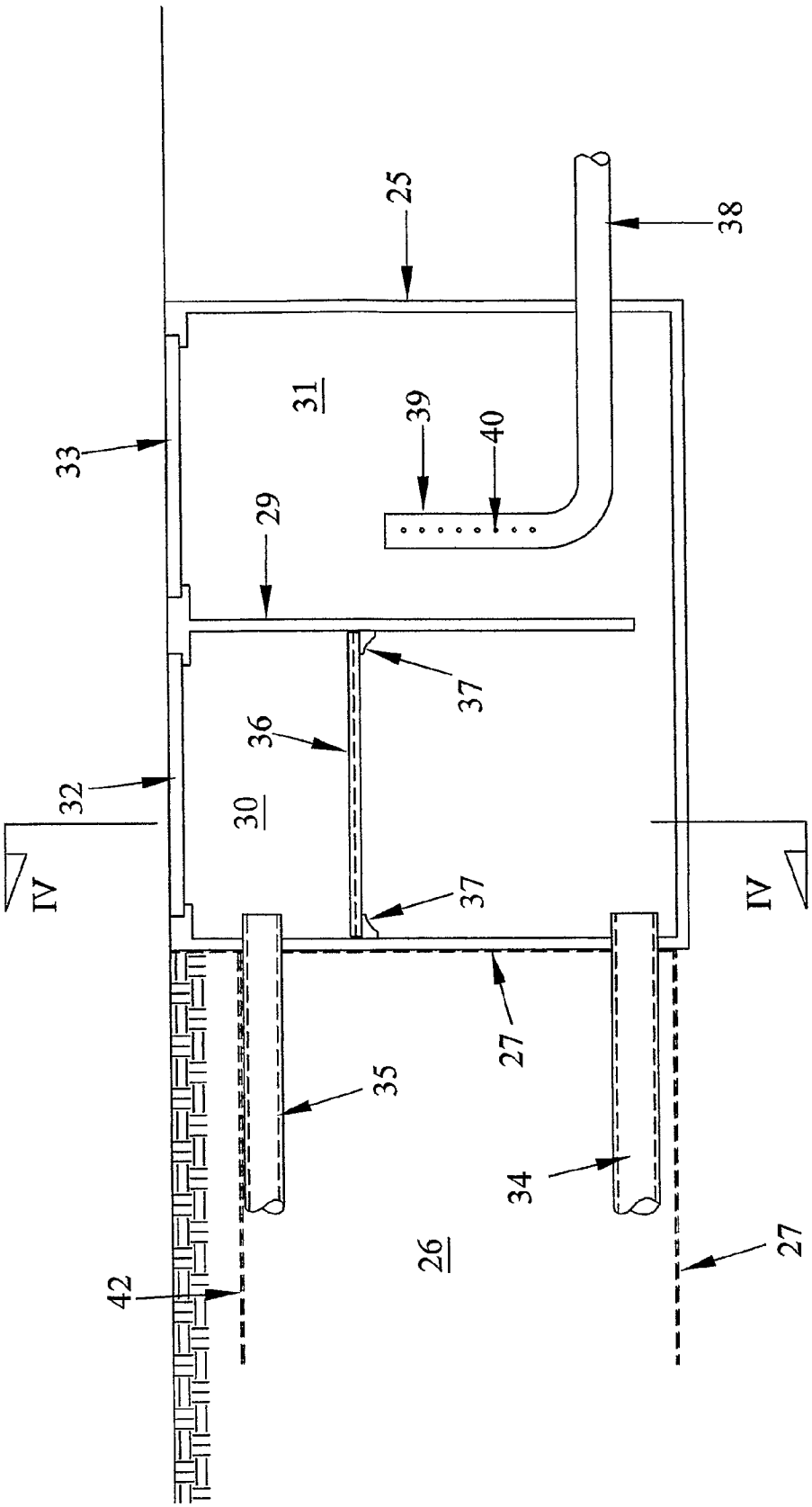


Figure 3

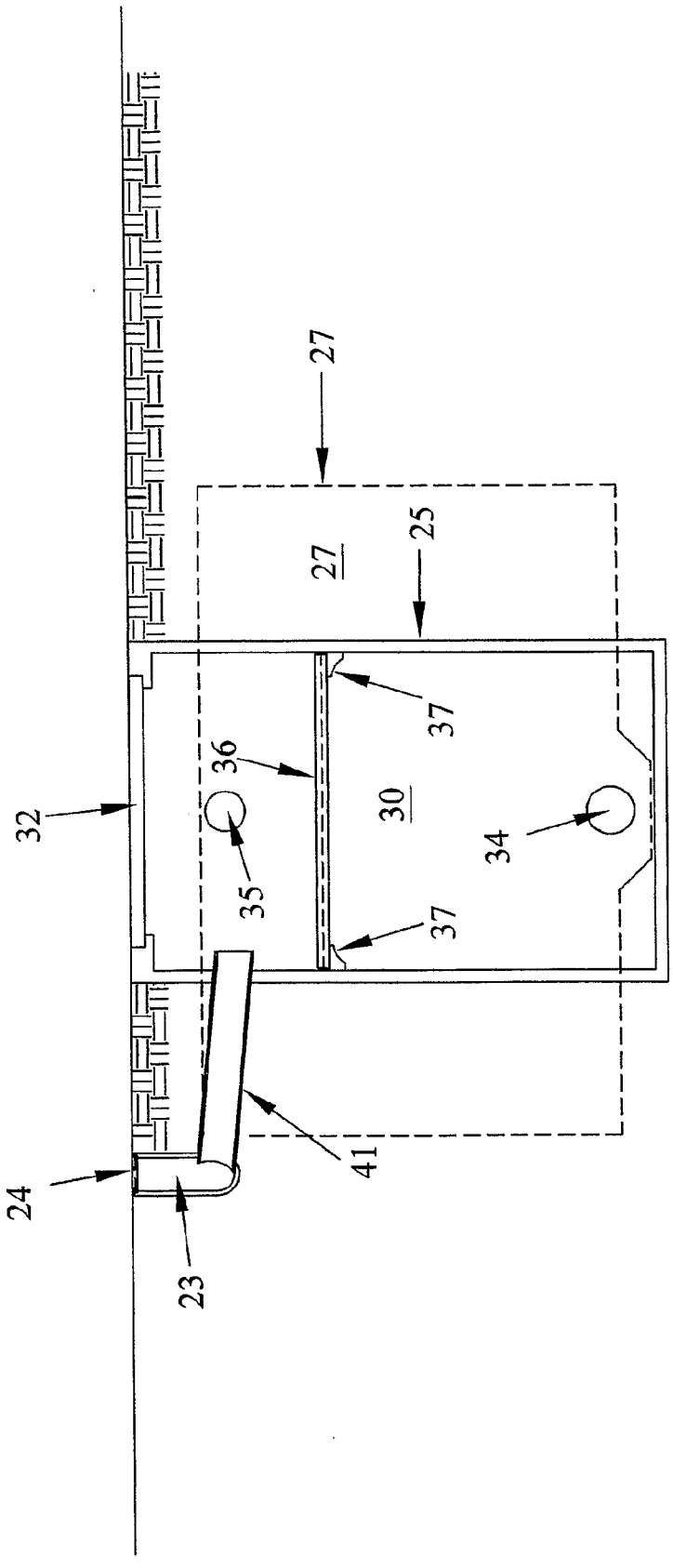


Figure 4

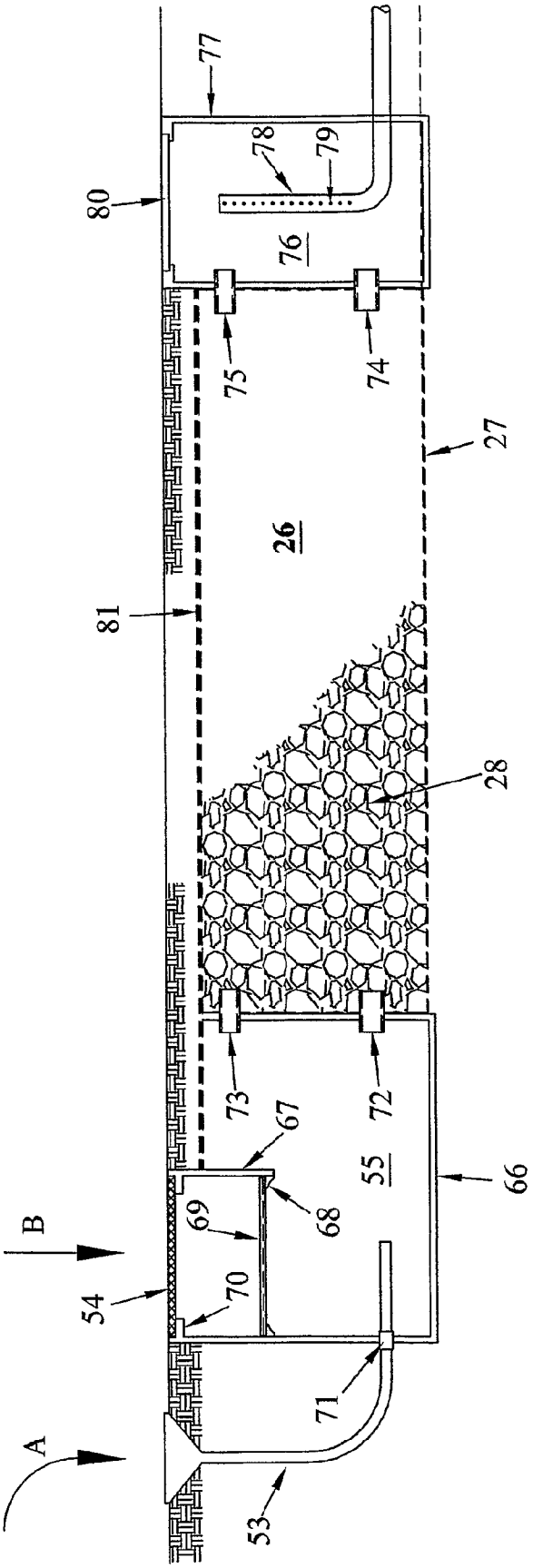


Figure 5

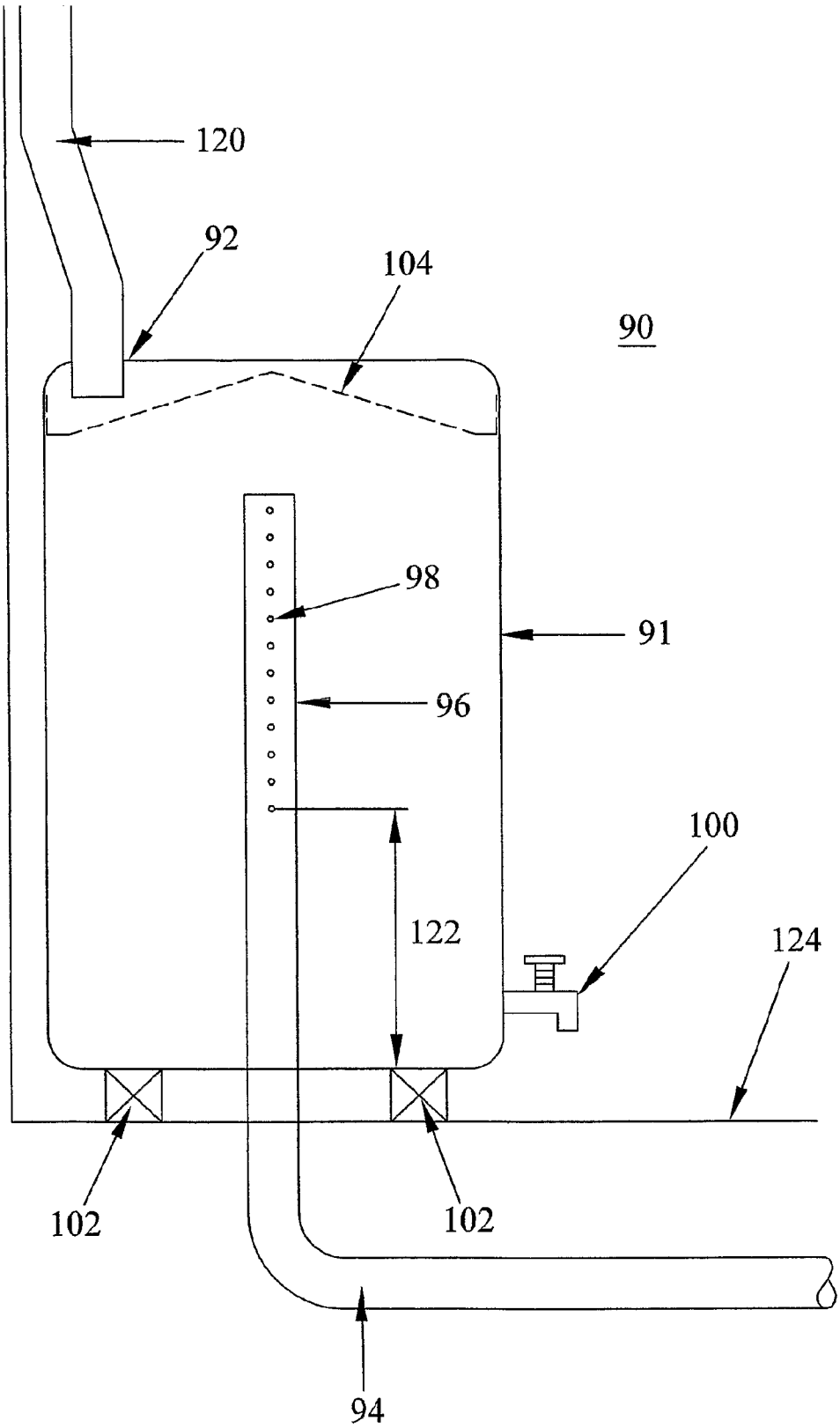


Figure 6

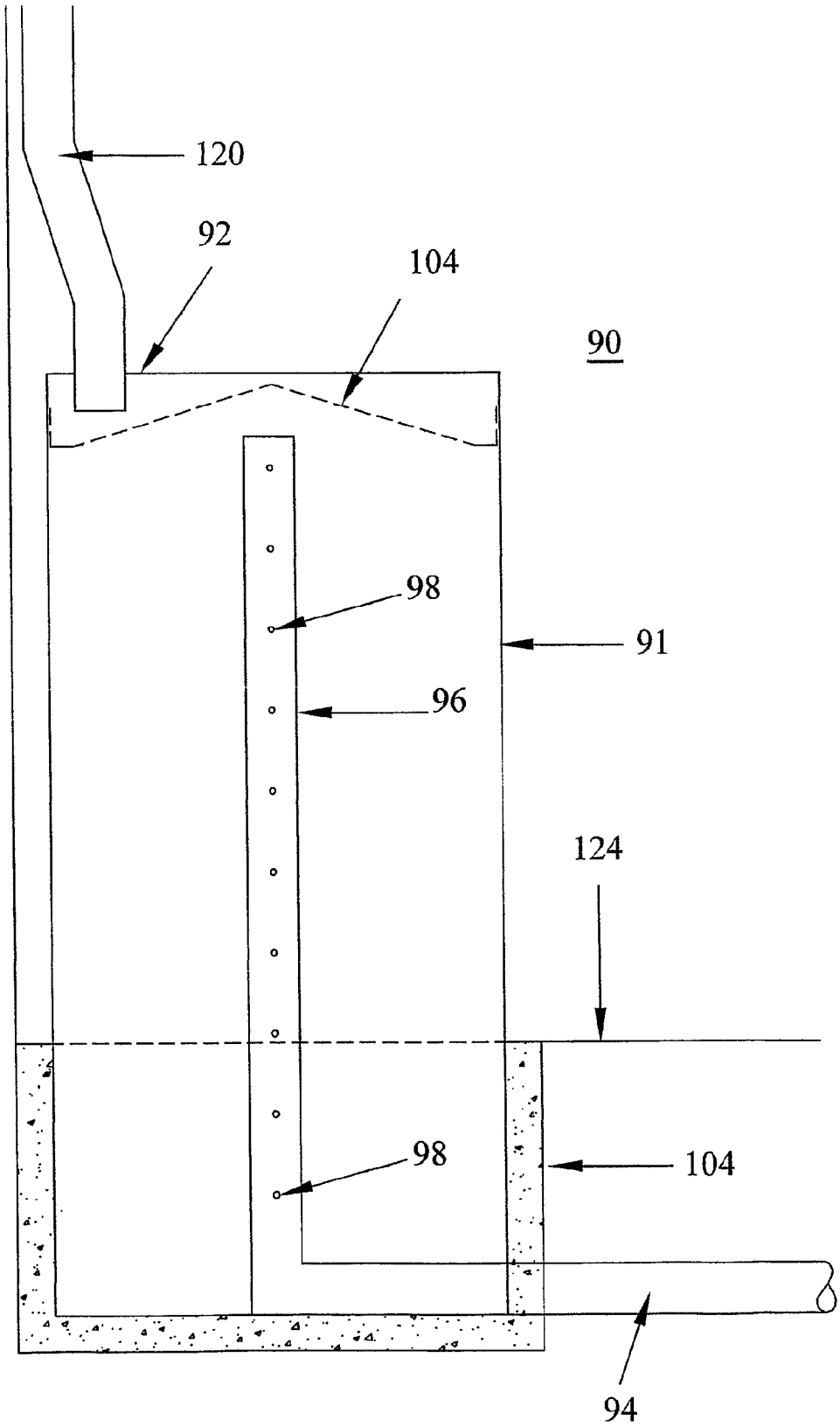


Figure 7