WATER CIRCULATION DEVICE AND WATER CIRCULATION SYSTEM

Cross-reference to Related Applications

[0001] The present application claims priority to Chinese Patent Application with the Application No. CN202420288843.5 filed with the China National Intellectual Property Administration on February 7, 2024 and entitled "WATER CIRCULATION DEVICE AND WATER CIRCULATION SYSTEM", contents of which are incorporated herein by reference in their entirety.

Technical Field

[0002] Embodiments of the present application relate to the field of water circulation utilization, in particular to a water circulation device and a water circulation system.

Background Art

[0003] Traditional road construction relies on the paving of ordinary bricks or concrete. During rainfall, the bricks and concrete do not absorb water and do not have water seepage, road surfaces are wet and slippery, and rainwater drainage is performed through urban drainage pipes. Due to heavy rain, torrential rain, large drainage amounts, and clogged drainage ponds, water accumulation on roads is often caused, and phenomena such as waterlogging even occur. Meanwhile, rainwater directly enters the urban drainage pipes to be drained, resulting in a low utilization rate of rainwater (freshwater resources) on urban road surfaces.

[0004] In order to solve problems such as drainage and water storage of urban pavements during rainfall, the concept of sponge cities is proposed. The sponge cities are to build cities like spongy bodies, which can have the effects of water absorption, water storage, water seepage, and water purification to resolve natural disasters caused by rainwater, making them hydroelastic cities that are flexible in regulation of rainwater.

[0005] However, building water storage equipment requires occupying precious urban land resources, and the water storage equipment is easily left idle in seasons with low precipitation, resulting in waste.

Summary

[0006] The main technical problem solved by embodiments of the present application is to provide a water circulation device and a water circulation system that can make full use of existing space to collect and utilize rainwater, increase a utilization rate of freshwater resources on the basis

of not occupying additional space, and can reduce the occurrence of an urban waterlogging phenomenon.

[0007] In order to solve the above technical problems, in a first aspect, an embodiment of the present application provides a water circulation system, which is used for being disposed within a drainage ditch and located below a drainage ditch cover, comprising:

[0008] a water reservoir used for collecting water filtered through the drainage ditch cover and having a first sidewall and a second sidewall opposite to each other;

[0009] a first connection port and a second connection port respectively disposed at corresponding positions on the first sidewall and the second sidewall for being connected to connection pipes to connect a plurality of water reservoirs and allow collected water to flow between the water reservoirs;

[0010] a drainage port disposed on a bottom wall of the water reservoir for draining the collected water;

[0011] a drainage plug used in conjunction with the drainage port to control drainage of the collected water.

[0012] In some embodiments, numbers of the first connection ports and the second connection ports are each two.

[0013] In some embodiments, the water reservoir further comprises a third sidewall and a fourth sidewall, and the first sidewall, the second sidewall, the third sidewall, and the fourth sidewall define a storage space for storing the collected water.

[0014] In some embodiments, a water cleaner is configured in the water reservoir.

[0015] In order to solve the above technical problems, in a second aspect, an embodiment of the present application provides a water circulation system, comprising:

[0016] a drainage ditch;

[0017] a drainage ditch cover used for covering the drainage ditch and filtering water flowing into the drainage ditch;

[0018] a plurality of water circulation devices as described in the first aspect above used for collecting the water filtered through the drainage ditch cover, wherein the water circulation devices are communicated through connection pipes.

[0019] In some embodiments, a shape of the water reservoir fits a shape of the drainage ditch cover and an available space of the drainage ditch.

[0020] In some embodiments, the drainage ditch cover is of a detachable structure and is detachable relative to the drainage ditch.

[0021] In some embodiments, the drainage ditch cover comprises a plate body formed by stacking multiple of hydrophobic filling layers, the hydrophobic filling layers have a large number of gaps, and the gaps form a drainage channel.

[0022] In some embodiments, a drainage groove is provided at a bottom portion of the plate body.

[0023] In some embodiments, the water circulation system further comprises:

[0024] a spray gun used for performing cleaning using collected water in the water reservoir.

[0025] Beneficial effects of the embodiments of the present application: Different from situations of the prior art, an embodiment of the present application provides a water circulation device that is disposed within a drainage ditch and located below a drainage ditch cover. Through the water reservoir in the water circulation device, collection of water is achieved. Through the first connection port and the second connection port, connection of a plurality of water reservoirs and flowing of collected water are achieved. Drainage of the collected water is controlled through the drainage port and the drainage plug, thereby achieving collection and utilization of rainwater. Excessive rainwater can be accommodated, and a large amount of water drainage caused by torrential rain is reduced, thereby reducing the probability of flood occurrence.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] One or more embodiments are exemplarily illustrated through figures in corresponding drawings. These exemplary illustrations do not constitute limitations to the embodiments. Elements with the same reference numerals in the drawings represent similar elements. Unless otherwise stated, the figures in the drawings do not constitute limitations on scale.

[0027] FIG. 1 is a schematic diagram of a water circulation device provided by an embodiment of the present application;

[0028] FIG. 2 is a schematic diagram of a water circulation system provided by an embodiment of the present application; and

[0029] FIG. 3 is a schematic diagram of a water circulation system provided by another embodiment of the present application.

DETAILED DESCRIPTION

[0030] The present application is described in detail below in combination with specific embodiments. The following embodiments facilitate a further understanding of the present application by those skilled in the art, but do not limit the present application in any form. It should be indicated that for those of ordinary skill in the art, several modifications and improvements can

be made without departing from the concept of the present application. These all belong to the scope of protection of the present application.

[0031] In order to make the objectives, technical solutions, and advantages of the present application clearer and more understandable, the present application is further described in detail below in combination with the drawings and embodiments. It should be understood that the specific embodiments described herein are only used to explain the present application and are not used to limit the present application.

[0032] It should be noted that, if there is no conflict, various features in the embodiments of the present application can be combined with each other, and they are all within the scope of protection of the present application. Additionally, although functional module division is performed in a schematic diagram of a device and a logical sequence is shown in a flowchart, in some cases, steps shown or described can be performed differently from the module division in the device or the sequence in the flowchart. In addition, words such as "first", "second", and "third" used herein do not limit data and execution orders, but only distinguish the same or similar items with basically the same functions and effects.

[0033] Unless otherwise defined, all technical and scientific terms used in the specification have the same meanings as commonly understood by those skilled in the technical field to which the present application belongs. In the specification, the terms used in the specification of the present application are only for the purpose of describing specific implementations and are not used to limit the present application. The term "and/or" used in the specification comprises any and all combinations of one or more of associated listed items.

[0034] In addition, technical features involved in various implementations of the present application described below can be combined with each other as long as they do not conflict with each other.

[0035] As shown in FIG. 1, an embodiment of the present application provides a water circulation device. The water circulation device 10 is disposed within a drainage ditch and located below a drainage ditch cover, comprising a water reservoir 11, a first connection port 12, a second connection port 13, a drainage port 14, and a drainage plug 15.

[0036] The water reservoir 11 is used for collecting water filtered through the drainage ditch cover and has a first sidewall and a second sidewall opposite to each other.

[0037] In some embodiments, the water reservoir 11 further comprises a third sidewall and a fourth sidewall, and the first sidewall, the second sidewall, the third sidewall, and the fourth sidewall define a storage space for storing collected water.

[0038] The water reservoir is not fixed in size and shape and can be customized according to use needs, so that the water reservoir can be used in conjunction with the drainage ditch cover and can mate the drainage ditch where it is to be placed in size or meet other specific requirements.

[0039] The water reservoir can be made of any durable material, for example, stainless steel, aluminum, polymethyl methacrylate, polyvinyl chloride, and the like.

[0040] The collected water of the water reservoir can have various uses, for example, can be used for cleaning road surfaces or irrigating lawns and green plants, and can also be transferred to other containers for further treatment and use to achieve the effect of water circulation and reutilization, thereby improving a utilization rate of freshwater resources.

[0041] The first connection port 12 and the second connection port 13 are disposed on the water reservoir 11, which are respectively disposed at corresponding positions on the first sidewall and the second sidewall. A plurality of water reservoirs can be connected by connecting connection pipes on the connection ports, one end of the water reservoir can be connected to other water reservoirs, or both ends of the water reservoir can be connected to other water reservoirs. After the plurality of water reservoirs are connected, the water collected in each water reservoir can flow to each other through the connection ports and the connection pipes, so that the collected water can be used in a centralized mode. When the amount of water in a certain water reservoir is too large, the collected water will be diverted to other water reservoirs, thereby improving the availability of the water circulation device. When there is no need to connect to other water reservoirs, sealing covers can be used to seal the connection ports to prevent the collected water from flowing out of the connection ports.

[0042] After the plurality of water reservoirs are connected through the connection pipes, a reservoir chain is formed. The collected water of the entire reservoir chain can be used at any water reservoir using a siphon phenomenon. Due to a large amount of available water, various uses are achieved, which can increase a utilization rate of the collected water. The siphon phenomenon is caused by attractive forces between liquid molecules and a potential energy difference, that is, a pressure difference of a water column is used to make water rise and then flow to a lower place. Since water surfaces at pipe openings are subjected to different atmospheric pressures, water flows from a side with a higher pressure to a side with a lower pressure until atmospheric pressures on both sides are equal, water surfaces in containers have the same height, and the water stops flowing. The water in the containers can be quickly pumped out using the siphon phenomenon.

[0043] In some embodiments, numbers of the first connection ports and the second connection ports are each two, which can allow the collected water to flow faster between the water reservoirs.

[0044] The drainage port 14 is disposed on a bottom wall of the water reservoir 11 for draining the collected water. There is also the drainage plug 15 used in conjunction with the drainage port 14. During water collection, the drainage plug 15 is used to seal the drainage port 14. When the collected water needs to be drained, the drainage plug 15 is removed to drain the collected water in the water reservoir.

[0045] In some embodiments, a water cleaner is configured in the water reservoir.

[0046] In order to better use the collected water, the water cleaner, such as a water purification agent, a disinfectant, or a sterilizer, can be added to the water reservoir. During use, one or more water cleaners can be added as needed.

[0047] The water purification agent is a medicament that can react with other impurities in water when put into the water. It is mainly for the purpose of purifying the water. Commonly used water purification agents comprise polyaluminum chloride, polyaluminum ferric chloride, basic aluminum chloride, polyacrylamide, ferrous sulfate, aluminum sulfate, polyferric sulfate, and the like. The use of the water purification agent achieves a strong purification effect and can remove heavy metals in the water. The treatment of raw water is not affected by water temperatures and pH values and has a wide range of uses. The treated water has high transparency and can be reused.

[0048] Specifically, a cleaning box can be disposed within the water reservoir. When the collected water needs to be treated, the water cleaner is put into the cleaning box, or the water cleaner is put into the cleaning box in advance before starting to collect water.

[0049] Configuring the water cleaner in the water reservoir can prevent the collected water in the water reservoir from producing excessive bacteria or other harmful substances, which affect a storage effect and a use effect of the collected water in a later period.

[0050] To sum up, the water circulation device provided by an embodiment of the present application is disposed within the drainage ditch and located below the drainage ditch cover. Through the water reservoir, collection of water is achieved. Through the first connection port and the second connection port, connection of a plurality of water reservoirs and flowing of collected water are achieved. Drainage of the collected water is controlled through the drainage port and the drainage plug, thereby achieving recycling of wastewater. Part of excessive rainwater can be accommodated, and a large amount of water drainage caused by torrential rain is reduced, thereby reducing the probability of flood occurrence.

[0051] Another embodiment of the present application further provides a water circulation system. Referring to FIG. 2 and FIG. 3, the water circulation system comprises a drainage ditch 30, a drainage ditch cover 20, and a plurality of water circulation devices 10 as described above.

[0052] The drainage ditch 30 is a pipe and a ditch used for drainage, and water flow can converge within the drainage ditch to be drained. Since water flowing into the drainage ditch easily carries silt, the drainage ditch is easily blocked. Moreover, when the water flow rate is too large and when drainage is not performed in time in the drainage ditch, water accumulation or even waterlogging may be caused. Therefore, in an embodiment of the present application, the drainage ditch cover 20 is disposed on the drainage ditch 30 for filtering water, and the water circulation device 10 is disposed within the drainage ditch 30 for storing water and reducing drainage pressure.

[0053] The drainage ditch cover 20 is a device used for covering the drainage ditch 30 and filtering the water flowing into the drainage ditch 30. The drainage ditch cover 20 is erected on the drainage ditch 30 and mates the drainage ditch 30 in width. The water flowing into the drainage ditch 30 is first filtered through the drainage ditch cover 20, thereby reducing the entry of impurities such as silt and debris into the water circulation device 10 and the drainage ditch 30, reducing the occurrence of a clogging phenomenon of the water circulation device 10 and the drainage ditch 30, and improving the availability of collected water.

[0054] In some embodiments, the drainage ditch cover is of a detachable structure and is detachable relative to the drainage ditch. Maintenance of the drainage ditch is facilitated. Moreover, the drainage cover in the water circulation device can be conveniently removed by simply removing the corresponding drainage ditch cover, thereby achieving easy drainage of the collected water.

[0055] In some embodiments, the drainage ditch cover comprises a plate body formed by stacking multiple of hydrophobic filling layers, and the hydrophobic filling layers have a large number of gaps to form a drainage channel. When the water flowing into the drainage ditch passes through the drainage ditch cover, it flows into the drainage ditch or the water circulation device through the gaps of the hydrophobic filling layers, leaving impurities such as withered leaves and shattered sand in the hydrophobic filling layers, and thus achieving unique permeation and filtration functions of the hydrophobic filling layers.

[0056] In some embodiments, a drainage groove is provided at a bottom portion of the plate body of the drainage ditch cover, and a discharge channel is formed by the drainage groove and the drainage channel for guiding rainwater on road surfaces.

[0057] The water circulation device 10 is used for collecting water filtered through the drainage ditch cover 20. The water circulation device 10 is disposed within the drainage ditch 30, erected below the drainage ditch cover 20, and connected to the drainage ditch cover 20 for collecting the water filtered through the drainage ditch cover 20. The collected water is stored in a water reservoir 11. A first connection port 12 and a second connection port 13 are respectively disposed on a first

sidewall and a second sidewall of the water reservoir 11. By connecting connection pipes 40 to the connection ports, a plurality of water circulation devices are connected together, so that the collected water can flow between the plurality of water circulation devices. Therefore, the collected water can be used in a centralized mode. A drainage port 14 is disposed on a bottom wall of the water reservoir 10, and there is a drainage plug used in conjunction with the drainage port. When the water needs to be stored, the drainage plug is used to seal the drainage port. When the collected water in the water reservoir needs to be drained, the drainage plug that seals the drainage port is removed to allow the collected water to flow out smoothly.

[0058] Further, a shape of the water reservoir 10 fits a shape of the drainage ditch cover 20 and an available space of the drainage ditch 30, and the shape of the water reservoir can be customized according to use environment of the water reservoir.

[0059] When the water circulation device is used in different drainage ditches and/or in conjunction with different drainage ditch covers, an appropriate water reservoir can be customized accordingly, so that the water reservoir can meet use demands.

[0060] In some embodiments, two adjacent water reservoirs 10 are spaced apart by a width of one drainage ditch cover 20 to facilitate use.

[0061] Further, the water reservoir can be made of any durable material, for example, stainless steel, aluminum, polymethyl methacrylate, polyvinyl chloride, and the like.

[0062] Further, a water cleaner can be configured in the water reservoir to clean the collected water, thereby improving the availability of the collected water or meeting specific recovering needs.

[0063] In some embodiments, the water circulation system further comprises a spray gun used for performing cleaning using collected water in the water reservoir.

[0064] The spray gun is used for achieving various uses using the collected water. For example, the spray gun can be used for flushing and cleaning the drainage ditch cover using the collected water in the water reservoir to keep it from being clogged by impurities such as dust, mud, and debris, thereby maintaining its permeation and filtration functions. When the drainage ditch cover with the water reservoir disposed below is flushed with the collected water, the water reservoir can repeatedly collect permeated and filtered water, and the collected water can be circulated and used again. For example, the spray gun can be used for cleaning a pavement or a street using the collected water in the water reservoir. For example, the collected water can be used for watering urban green plants.

[0065] To sum up, the water circulation system provided in an embodiment of the present application comprises the drainage ditch, the drainage ditch cover, and a plurality of the water

circulation devices, wherein the water circulation devices are communicated through the connection pipes. According to the water circulation system, the drainage ditch cover can be used for covering the drainage ditch and filtering the water flowing into the drainage ditch, and then the water circulation device is used for collecting the water filtered through the drainage ditch cover, which can achieve filtration and recycling of rainwater, thus achieving water circulation. Moreover, part of excessive rainwater can be accommodated, and a large amount of water drainage caused by torrential rain is reduced, thereby reducing the probability of flood occurrence, facilitating the construction of sponge cities, and improving the adaptability of cities to aspects such as environmental changes and natural disasters caused by rainwater.

[0066] Finally, it should be noted that the above embodiments are only used to describe the technical solutions of the present application and are not intended to limit the present application. Under the concept of the present application, technical features in the above embodiments or different embodiments can also be combined, steps can be implemented in any order, and there are many other variations of different aspects of the present application as described above. For the sake of brevity, they are not provided in detail. Although the present application is described in detail with reference to the foregoing embodiments, those of ordinary skill in the art should understand that modifications can still be made to the technical solutions described in the foregoing embodiments, or equivalent substitutions can be made to some of the technical features. These modifications or substitutions do not cause the essence of the corresponding technical solutions to deviate from the scope of the technical solutions of the embodiments of the present application.

WHAT IS CLAIMED IS:

1. A water circulation device, wherein the water circulation device is used for being disposed within a drainage ditch and located below a drainage ditch cover, comprising:

a water reservoir used for collecting water filtered through the drainage ditch cover and having a first sidewall and a second sidewall opposite to each other;

a first connection port and a second connection port respectively disposed at corresponding positions on the first sidewall and the second sidewall for being connected to connection pipes to connect a plurality of water reservoirs and allow collected water to flow between the water reservoirs;

a drainage port disposed on a bottom wall of the water reservoir for draining the collected water;

a drainage plug used in conjunction with the drainage port to control drainage of the collected water.

2. The water circulation device according to claim 1, wherein numbers of the first connection ports and the second connection ports are each two.

3. The water circulation device according to claim 1, wherein the water reservoir further comprises a third sidewall and a fourth sidewall, and the first sidewall, the second sidewall, the third sidewall, and the fourth sidewall define a storage space for storing the collected water.

4. The water circulation device according to any one of claims 1-3, wherein a water cleaner is configured in the water reservoir.

5. A water circulation system, comprising:

a drainage ditch;

a drainage ditch cover used for covering the drainage ditch and filtering water flowing into the drainage ditch;

a plurality of water circulation devices according to any one of claims 1-4 used for collecting the water filtered through the drainage ditch cover, wherein the water circulation devices are communicated through connection pipes.

6. The water circulation system according to claim 5, wherein a shape of the water reservoir fits a shape of the drainage ditch cover and an available space of the drainage ditch.

7. The water circulation system according to claim 5, wherein the drainage ditch cover is of a detachable structure and is detachable relative to the drainage ditch.

8. The water circulation system according to claim 7, wherein the drainage ditch cover comprises a plate body formed by stacking multiple of hydrophobic filling layers, the hydrophobic filling layers have a large number of gaps, and the gaps form a drainage channel.

9. The water circulation system according to claim 8, wherein a drainage groove is provided at a bottom portion of the plate body.

10. The water circulation system according to claim 5, further comprising:

a spray gun used for performing cleaning using collected water in the water reservoir.