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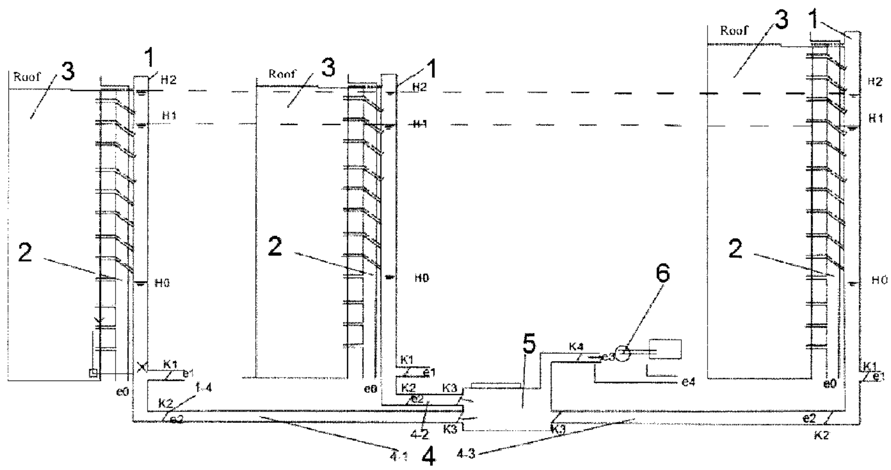
(54) Title: SYSTEM FOR GENERATING POWER USING ENERGY-STORAGE WATER PIPES OF MULTIPLE HIGH-RISE BUILDINGS



(57) Abrégé/Abstract:
A system for generating power using energy-storage water pipes of multiple high-rise buildings is disclosed. The system includes an energy-storage water pipe device mating with a power generation system, and a sewer pipeline device, an underground communicated water diversion pipeline, an underground pressure reservoir and a water turbine. Each building is provided with one energy-storage water pipe device and one sewer pipeline device. The energy-storage water pipe device introduces rainwater and domestic sewage into an energy-storage water pipe via the water diversion pipeline. Each building is provided with one underground communicated water diversion pipeline, which introduces water in the energy-storage water pipe into the underground pressure reservoir. The underground pressure reservoir balances the water level of each energy-storage water pipe. Power generation starts when the water level in the energy-storage water pipe exceeds a certain height H_1, and stops when the water level drops to H_0.

ABSTRACT

A system for generating power using energy-storage water pipes of multiple high-rise buildings is disclosed. The system includes an energy-storage water pipe device mating with a power generation system, and a sewer pipeline device, an underground communicated water diversion pipeline, an underground pressure reservoir and a water turbine. Each building is provided with one energy-storage water pipe device and one sewer pipeline device. The energy-storage water pipe device introduces rainwater and domestic sewage into an energy-storage water pipe via the water diversion pipeline. Each building is provided with one underground communicated water diversion pipeline, which introduces water in the energy-storage water pipe into the underground pressure reservoir. The underground pressure reservoir balances the water level of each energy-storage water pipe. Power generation starts when the water level in the energy-storage water pipe exceeds a certain height H_1, and stops when the water level drops to H_0.

SYSTEM FOR GENERATING POWER USING ENERGY-STORAGE WATER PIPES OF MULTIPLE HIGH-RISE BUILDINGS

Technical Field

The present invention relates to the technical field of energy recycling and utilization, and in particular, to a system for generating power using energy-storage water pipes of multiple high-rise buildings.

Background

With the development of our country's economy and the continuous improvement of living standards, the environmental pollution caused by domestic sewage is increasingly aggravated. At present, the discharge amount of domestic sewage in China is increasing, and the treatment and recycling of domestic sewage is particularly important.

Summary

The technical problem to be solved by the present invention is to overcome the defects of the prior art, and a system for generating power using energy-storage water pipes of multiple high-rise buildings is provided for storing sewage of multiple high-rise buildings by means of multiple energy-storage water pipes, and collecting the sewage together for centralized power generation, thereby rationally reusing the water resources.

To solve the foregoing technical problem, the present invention provides a system for generating power using energy-storage water pipes of multiple high-rise buildings, including an energy-storage water pipe device, and a sewer pipeline device, an underground communicated water diversion pipeline, an underground pressure reservoir and a water turbine and power generation system mating with the energy-storage water pipe device, where each high-rise building is provided with one energy-storage water pipe device and one sewer pipeline device;

the energy-storage water pipe device is disposed beside the high-rise building sewer pipeline, and the energy-storage water pipe device includes a rainwater inlet pipeline, an energy-storage sewage water diversion pipeline, an energy-storage water pipe, and an energy-storage sewage drainage pipeline; the rainwater inlet pipeline is disposed on the roof and is directly communicated with the energy-storage water pipe, and the rainwater on the roof is introduced into the energy-storage water pipe from the rainwater inlet pipeline; the rainwater inlet pipeline has an upward-facing gap in the sewer pipeline; the energy-storage sewage water diversion pipeline is disposed from the fifth floor, and is connected to the energy-storage water pipe by means of a valve; the energy-storage sewage water diversion pipeline has an upward-facing gap in the sewer pipeline; when the water level in the energy-storage water pipe is below the valve, the valve opens; as the water level gradually rises, the valve is closed by the water pressure, and in this case, the sewage flows from the gap to the sewer pipeline; three water levels are set in the energy-storage water pipe, i.e., a stop water level H_0, a power generation water level H_1, and a highest water level H_2 respectively, and the liquid level height is sensed by means of a liquid level signaling device; when the water level in the energy-storage water pipe reaches the power generation water level H_1, the water turbine starts to generate power; when the water level drops to the stop water level H_0, the power generation is stopped; when the water level reaches the highest water level H_2, the excess sewage flows into the sewer pipeline from the upward-facing gap of the rainwater inlet pipeline; and the sewage drainage pipeline discharges the sewage to a sewer pipe network when cleaning the energy-storage water pipe;

the pipeline device includes a backup rainwater inlet pipeline, a sewage water diversion pipeline, a sewer pipeline, and a sewage drainage pipeline; the rainwater inlet pipeline is disposed above the rainwater inlet pipeline, and the backup rainwater inlet pipeline is connected to the sewer pipeline; when accumulated water reaches the height of the backup rainwater inlet pipeline, the accumulated water flows directly from the backup rainwater inlet pipeline through the sewer pipeline; the sewage water diversion pipeline is disposed from the first floor; the sewage water diversion pipelines from the first floor to the fourth floor are directly connected to the sewer pipeline, and the sewage water diversion pipelines above the fourth floor are connected to the energy-storage sewage water diversion pipeline in the energy-storage water pipe device; and the sewage is directly discharged from the pipeline into the sewer pipe network by means of the sewage drainage pipeline;

the underground communicated water diversion pipelines are arranged underground, each high-rise building is provided with one underground communicated water diversion pipeline, and water in the energy-storage water pipes of the respective high-rise building is introduced into the underground pressure reservoir by means of each underground communicated water diversion pipeline;

the underground pressure reservoir has multiple energy-storage water pipe inlets and a water outlet pipeline; the energy-storage water pipes of each high-rise building correspond to one energy-storage water pipe inlet; water in the energy-storage water pipes is collected into a container, and the water outlet pipeline is used for introducing water in the container into the water turbine and power generation system;

the water turbine and power generation system includes a power generation water inlet pipeline, a water turbine, a generator, a receiving pool, and a receiving pool drainage pipeline; the power generation water inlet pipeline is communicated with the underground pressure reservoir to guide the sewage to the water turbine, so that the water turbine is rotated to drive the generator to work, and electric energy is output to the grid or directly to power a high-rise tap water booster pump; the receiving pool is a water storage device, and excess water is discharged to the sewer pipe network by means of the receiving pool drainage pipeline.

When the heights of multiple high-rise buildings are the same, the stop water level H_0 is 1/3 of the entire building height, the power generation water level H_1 is the sub-top floor of the entire building height, and the highest water level H_2 is the entire building height. When the heights of multiple high-rise buildings are different, the stop water level H_0 is 1/3 of the lowest building height, the power generation water level H_1 is the sub-top floor of the lowest building height, and the highest water level H_2 is the lowest building height.

A normally closed valve k1 is disposed in the energy-storage sewage drainage pipeline, and is open during the decontamination cleaning of the water pipe.

Each of the underground communicated water diversion pipelines is provided therein with a valve k2 which is in a normally open state and is closed during system maintenance or sewage disposal.

The energy-storage water pipe inlet is provided with a valve k3 which is in a normally open state and is closed during sewage disposal.

The power generation water inlet pipeline and the water turbine are connected by means of a normally open valve k4 which is closed during the decontamination cleaning of the water pipe.

The volume of a container of the underground pressure reservoir is 50% of the volume of one energy-storage water pipe.

The water turbine and power generation systems are arranged on the ground, and if arranged underground, it is necessary to ensure that the effluent automatically flows into an urban sewage pipe network.

The water turbine is an impulse water turbine.

The high-rise buildings are residential buildings having 10 floors or more or the building height greater than 28 m.

The present invention has the following advantageous effects.

The present invention stores the sewage of multiple high-rise buildings by means of multiple energy-storage water pipes, and collects the sewage together for centralized power generation, and the generated electric energy is output to the grid or is supplied to the booster pump, thereby greatly saving energy, rationally reusing water resources, and improving the environment, and thus, the economic benefits, environmental benefits and social benefits are significant.

Brief Description of the Drawings

FIG. 1 is a structural diagram of a system for generating power using energy-storage water pipes of multiple high-rise buildings of the present invention;

FIG. 2 is an arrangement diagram of an energy-storage water pipe device of the present invention;

FIG. 3 is an arrangement diagram of a sewer pipeline device of the present invention;

FIG. 4 is an arrangement diagram of an underground pressure reservoir device in the present invention; and

FIG. 5 is an arrangement diagram of a water turbine and power generation system of the present invention.

In the drawings:

H_0 is a stop water level of the energy-storage water pipe, H_1 is a power generation water level of the energy-storage water pipe, and H_2 is a highest water level of the energy-storage water pipe;

a_1 is an opening of a rainwater inlet pipeline, and a_2 is an opening of a backup rainwater inlet pipeline;

b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9, b_{10}, b_{11}, and b_{12} are inlets of the sewage water diversion pipelines of the floors;

c_5, c_6, c_7, c_8, c_9, c_{10}, c_{11}, and c_{12} are upward-facing gaps of the energy-storage sewage water diversion pipeline in the sewer pipeline;

d_5, d_6, d_7, d_8, d_9, d_{10}, d_{11}, and d_{12} are valves through which the energy-storage sewage water diversion pipeline is connected to the energy-storage water pipe;

e_0 is an outlet of the sewer pipeline, e_1 is an outlet of the energy-storage water pipe into the sewer pipe network, e_2 is an inlet of the energy-storage water pipe into the underground communicated water diversion pipeline, e_3 is an inlet of the power generation inlet pipeline into the receiving pool, and e_4 is an outlet of the receiving pool drainage pipeline into the sewer pipe network; and

k_1 is a normally closed valve, k_2 is a normally open valve, k_3 is a pressure reservoir inlet valve, i.e., a normally open valve, k_4 is a power generation inlet pipe valve which is open during power generation and closed during non-power generation.

Detailed Description

The present invention is further described below. The following embodiments are only intended to illustrate the technical solution of the present invention more clearly, and are not intended to limit the scope of protection of the present invention.

As shown in FIG. 1, a system for generating power using energy-storage water pipes of multiple high-rise buildings of the present invention includes multiple high-rise building energy-storage water pipe devices 1, sewer pipeline devices 2, an underground communicated water diversion pipeline 4, an underground pressure reservoir 5 and a water turbine and power generation system 6 mating with the energy-storage water pipe devices. Specifically,

As shown in FIG. 2, each high-rise building is provided with one energy-storage water pipe device and one sewer pipeline device. The energy-storage water pipe device 1 is disposed beside the high-rise building sewer pipeline. The energy-storage water pipe device 1 includes a rainwater inlet pipeline 1-1, an energy-storage sewage water diversion pipeline 1-2, an energy-storage water pipe 1-3, and an energy-storage sewage drainage pipeline 1-4, where the rainwater inlet pipeline 1-1 is disposed at the top of the floor, and is directly communicated with the energy-storage water pipe 1-3, so as to introduce the roof rainwater into the energy-storage water pipe 1-3 from the rainwater inlet pipeline. In FIG. 2, a_1 is an opening of the rainwater inlet pipeline. The rainwater inlet pipeline 1-1 has an upward-facing gap in a sewer pipeline 2-3. When the water level of the energy-storage water pipe 1-3 reaches the highest water level H_2, water overflows into the sewer pipeline 2-3 via the gap. When large-scale rainwater falls, the accumulated water on the roof can be directly discharged from the sewer pipeline 2-3 by means of a backup rainwater inlet pipeline 2-1. In FIG. 2, a_2 is an opening of the backup rainwater inlet pipeline. The energy-storage sewage water diversion pipeline 1-2 is disposed from the fifth floor, is connected to the energy-storage water pipe 1-3 by means of valves (d_5-d_{12}), and has an upward-facing gap (c_5-c_{12}) in the sewer pipeline. When the water level in the energy-storage water pipe 1-3 is below the valve, the valve is open. As the water level gradually rises, the valve is closed by means of the water pressure, and in this case, the sewage flows from the gap to the sewer pipeline. Three water levels are set in the energy-storage water pipe 1-3, i.e., a stop water level H_0, apower generation water level H_1, and a highest water level H_2 respectively, and the liquid level height is sensed by means of a liquid level signaling device. When the heights of multiple high-rise buildings are the same, H_0 is 1/3 of the entire building height, H_1 is the sub-top floor of the entire building height, and H_2 is the entire building height. When the heights of multiple high-rise buildings are different, H_0 is 1/3 of the lowest building height, H_1 is the sub-top floor of the lowest building height, and H_2 is the lowest building height. The water level in the energy-storage water pipe of each high-rise building is the same due to the underground communicated water diversion pipeline. When the water level in the energy-storage water pipe 1-3 reaches the power generation water level H_1, the water turbine starts to generate power. When the water level drops to the stop water level H_0, the power generation is stopped. In the case of heavy rain, when the water level reaches the highest water level H_2, the excess sewage flows into the sewer pipeline from the upward-facing gap of the rainwater inlet pipeline 1-1, or directly flows into the sewer pipeline from the backup rainwater inlet pipeline. The sewage is discharged to the sewer pipe network by means of the energy-storage sewage drainage pipeline 1-4 when cleaning the energy-storage water pipe 1-3. The normally closed valve k_1 is provided in the energy-storage sewage drainage pipeline 1-4, and is open during the decontamination cleaning of the water pipe. In the drawings, e_1 is an outlet of the energy-storage water pipe into the sewer pipe network, is in the normally closed state, and is open during the decontamination cleaning of the water pipe.

As shown in FIG. 3, the sewer pipeline device 2 includes a backup rainwater inlet pipeline 2-1, a sewage water diversion pipeline 2-2, a sewer pipeline 2-3, and a sewage drainage pipeline 2-4, where the backup rainwater inlet pipeline 2-1 is disposed above the rainwater inlet pipeline 1-1, and the backup rainwater inlet pipeline 2-1 is communicated with the sewer pipeline 2-3. In the case that large-scale rainwater falls, when accumulated water reaches the height of the backup rainwater inlet pipeline 2-1, the accumulated water directly flows from the backup rainwater inlet pipeline into the sewer pipeline 2-3. The sewage water diversion pipeline 2-2 is disposed from the first floor, the sewage water diversion pipelines 2-2 from the first floor to the fourth floor are directly connected to the sewer pipeline 2-3, and the sewage water diversion pipelines 2-2 above the fourth floor are connected to the energy-storage sewage water diversion pipeline 1-2 in the energy-storage water pipe device 1. In the drawings, b_1-b_{12} are inlets of the sewage water diversion pipelines. The sewage is directly discharged from the sewer pipeline 2-3 into the sewer pipe network by means of the sewage drainage sewer pipeline 2-4. In the drawing, e_0 is the outlet of the sewer pipeline.

Since each high-rise building is equipped with energy-storage water pipes. Water in multiple energy-storage water pipes is communicated by means of underground communicated water diversion pipelines 4, and the underground communicated water diversion pipelines 4 are arranged underground, without affecting the road traffic within a community. Each high-rise building is equipped with an underground communicated water diversion pipeline, such as 4-1, 4-2, and 4-3 in FIG. 1. Each underground communicated water diversion pipeline introduces water from the energy-storage water pipes of the respective high-rise buildings into an underground pressure reservoir 5. Water in multiple energy-storage water pipes is collected together by means of the balancing action of the underground pressure reservoir 5 and the underground communicated water diversion pipeline, so that the water levels in the different energy-storage water pipes can be adjusted to each other to reach the balanced water level. Each underground communicated water diversion pipeline is provided therein with a valve k2 which is normally open and is open during system maintenance or sewage disposal, and the underground communicated water diversion pipeline has the function of a communicating vessel. In the drawings, e_2 is an inlet of the energy-storage water pipe into the underground communicated water diversion pipeline.

As shown in FIG. 4, the underground pressure reservoir 5 has multiple energy-storage water pipe inlets and a water outlet pipeline. The energy-storage water pipes of each high-rise building correspond to one energy-storage water pipe inlet, such as 5-1, 5-2, and 5-3 in FIG. 3. A valve k_3 is provided at the energy-storage water pipe inlet, and the valve k_3 is normally open, and is closed during sewage disposal. 5-4 is a water outlet pipeline of the pressure reservoir, and 5-5 is a container for collecting water in multiple energy-storage water pipes. The volume of the container should not be too large, generally 2-3 m^3, which is 50% of the volume of one energy-storage water pipe and has the function of balancing the water level in the energy-storage water pipes of multiple high-rise buildings. The container should have the high-pressure resistant ability (if the height of the building is 100 m, it must resist more than 10 atmospheres, and it is necessary to retain a certain high-pressure resistant margin, and it is appropriate to take 12 atmospheres). 5-6 is an access door of the underground pressure reservoir, and is normally closed. When sewage disposal is required, three valves k_3 are closed, and the access door of the reservoir is open, so as to clean the pressure reservoir.

As shown in FIG. 5, the water turbine and power generation system 6 includes a power generation water inlet pipeline 6-1, a water turbine 6-2, a generator 6-3, a receiving pool 6-4, and a receiving pool drainage pipeline 6-5, where the power generation water inlet pipeline 6-1 and the water turbine 6-2 are connected by means of a normally open valve k_4, and the normally open valve k_4 is closed during the decontamination cleaning of the water pipe. The power generation water inlet pipeline 6-1 is communicated with the underground pressure reservoir, and the sewage is introduced to the water turbine 6-2, so that the water turbine 6-2 is rotated to drive the generator 6-3 to work, and the electric energy is output to the grid or to directly power a high-rise tap water booster pump. The receiving pool 6-4 is a water storage device, and the excess water is discharged to the sewer pipe network by means of the receiving pool drainage pipeline 6-5. In the drawings, e_3 is an inlet of the power generation water inlet pipeline into the receiving pool, and e_4 is an outlet of the receiving pool drainage pipeline into the sewer pipe network.

The water turbine and power generation systems should be arranged on the ground, and if arranged underground, it is necessary to ensure that the effluent automatically flows into an urban sewage pipe network. The water turbine 6-2 of the present invention adopts an impulse water turbine for generating power, and the generated electric energy can be output to the grid, or to directly power the high-rise tap water booster pump. The impulse water turbine is characterized by a small flow, high lift and wide efficiency zone. Moreover, compared with a single energy-storage water pipe, the flow rate of the water turbine is increased, and the output power and stability of the hydroelectric power generation system are greatly improved.

The high-rise buildings of the present invention are preferably residential buildings having 10 floors or more or the building height greater than 28 m, so that the system has good applicability and economic value.

The contents above are only preferred embodiments of the present invention, and it should be noted that a person of ordinary skill in the art can make several improvements and modifications, without departing from the technical principles of the present invention. The improvements and modifications should also be construed within the protection scope of the present invention.

What is claimed is:

1. A system for generating power using a plurality of energy-storage water pipes from a plurality of high-rise buildings, the system comprising:

an underground pressure reservoir,

a power generation system equipped with a water turbine,

a plurality of energy-storage water pipe devices, each of the plurality of energy-storage water pipe devices comprising one of the plurality of energy-storage water pipes,

a plurality of sewer pipeline devices, each one of the plurality of sewer pipelines devices mating with each one of the plurality of energy-storage water pipe devices, and

a plurality of underground communicated water diversion pipelines,

a plurality of energy-storage water pipe devices, one of the plurality of sewer pipeline devices and one of the plurality of underground communicated water diversion pipelines;

wherein the each of the plurality of high-rise buildings has a sewer pipeline being disposed beside the energy-storage water pipe device;

the energy-storage water pipe device further comprises a rainwater inlet pipeline on a roof of the high-rise building and directly communicating with the energy-storage water pipe such that rainwater on the roof is introduced into the energy-storage water pipe from the rainwater inlet pipeline, an energy-storage sewage water diversion pipeline disposed at each floor from a fifth floor to a top floor of the high-rise building, and an energy-storage sewage drainage pipeline;

wherein the rainwater inlet pipeline has an upward-facing gap in the sewer pipeline;

the energy-storage sewage water diversion pipeline is connected to the energy-storage water pipe by a valve and has an upward-facing gap in the sewer pipeline;

when a water level in the energy-storage water pipe is below the valve, the valve opens; as the water level gradually rises, the valve is closed under water pressure, and sewage flows from the upward-facing gap of the energy-storage sewage water diversion pipeline to the sewer pipeline; and

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the energy-storage water pipe is preset with a stop water level H_0, a power generation water level H_1, and a highest water level H_2, and a water level is sensed by means of a liquid level signaling device; when the water level in the energy-storage water pipe reaches the power generation water level H_1, the water turbine starts to generate power; when the water level drops to the stop water level H_0, the water turbine stops; when the water level reaches the highest water level H_2, an excess sewage flows into the sewer pipeline from the upward-facing gap of the rainwater inlet pipeline; and the energy-storage sewage drainage pipeline discharges water discharged from cleaning the energy-storage water pipe to a sewer pipe network;

the sewer pipeline device comprises a backup rainwater inlet pipeline disposed above the rainwater inlet pipeline and connected to the sewer pipeline, a sewage water diversion pipeline disposed at each floor of the high-rise building, and a sewage drainage pipeline connected to the sewer pipeline;

wherein when accumulated water reaches a height of the backup rainwater inlet pipeline, the accumulated water flows directly from the backup rainwater inlet pipeline into the sewer pipeline; the sewage water diversion pipelines from a first floor to a fourth floor of the high-rise building are directly connected to the sewer pipeline, and the sewage water diversion pipelines above the fourth floor are connected to the energy-storage sewage water diversion pipeline in the energy-storage water pipe device; and the sewage is directly discharged from the sewer pipeline into the sewer pipe network by means of the sewage drainage pipeline;

the plurality of underground communicated water diversion pipelines are arranged underground; and water in the plurality of energy-storage water pipes is introduced into the underground pressure reservoir by the plurality of underground communicated water diversion pipelines;

the underground pressure reservoir has a plurality of energy-storage water pipe inlets and a water outlet pipeline; each of the plurality of energy-storage water pipe corresponds to each of the plurality of energy-storage water pipe inlets; water in the each energy-storage water pipe is collected into a container, and the water outlet pipeline is used for introducing the water in the container into the water turbine and power generation system; and

the power generation system further comprises a power generation water inlet pipeline, a

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generator, a receiving pool comprising a water storage device and a receiving pool drainage pipeline;

wherein the power generation water inlet pipeline communicates with the underground pressure reservoir to guide the sewage to the water turbine, so that the water turbine is rotated to drive the generator to work, and the power generated is output to a grid or is used directly to power a high-rise building tap water booster pump; and excess water is discharged to the sewer pipe network by the receiving pool drainage pipeline.

2. The system according to claim 1, wherein

when heights of the plurality of high-rise buildings are the same, the stop water level H_0 is 1/3 of an entire building height, the power generation water level H_1 is a sub-top floor of the entire building height, and the highest water level H_2 is the entire building height; and

when the heights of the plurality of high-rise buildings are different, the stop water level H_0 is 1/3 of a lowest building height, the power generation water level H_1 is a sub-top floor of the lowest building height, and the highest water level H_2 is the lowest building height.

3. The system according to claim 1, wherein a normally closed valve k1 is disposed in the energy-storage sewage drainage pipeline, and is open during a decontamination cleaning of the energy-storage water pipe.

4. The system according to claim 1, wherein each of the plurality of underground communicated water diversion pipelines is provided therein with a valve k2 which is normally in an open state and is closed during system maintenance or sewage disposal.

5. The system according to claim 1, wherein the each of the plurality of energy-storage water pipe inlet is provided with a valve k3 which is normally in an open state and is closed during sewage disposal.

6. The system according to claim 1, wherein the power generation water inlet pipeline and the water turbine are connected by an open valve k4 which is normally in an open state and is closed during a decontamination cleaning of the energy-storage water pipe.

7. The system according to claim 1, wherein a volume of the container of the underground pressure

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reservoir is 50% of a volume of the energy-storage water pipe.

8. The system according to claim 1, wherein the water turbine is an impulse water turbine.

9. The system according to claim 1, wherein the high-rise buildings are residential buildings having 10 floors or more or having a building height greater than 28 m.

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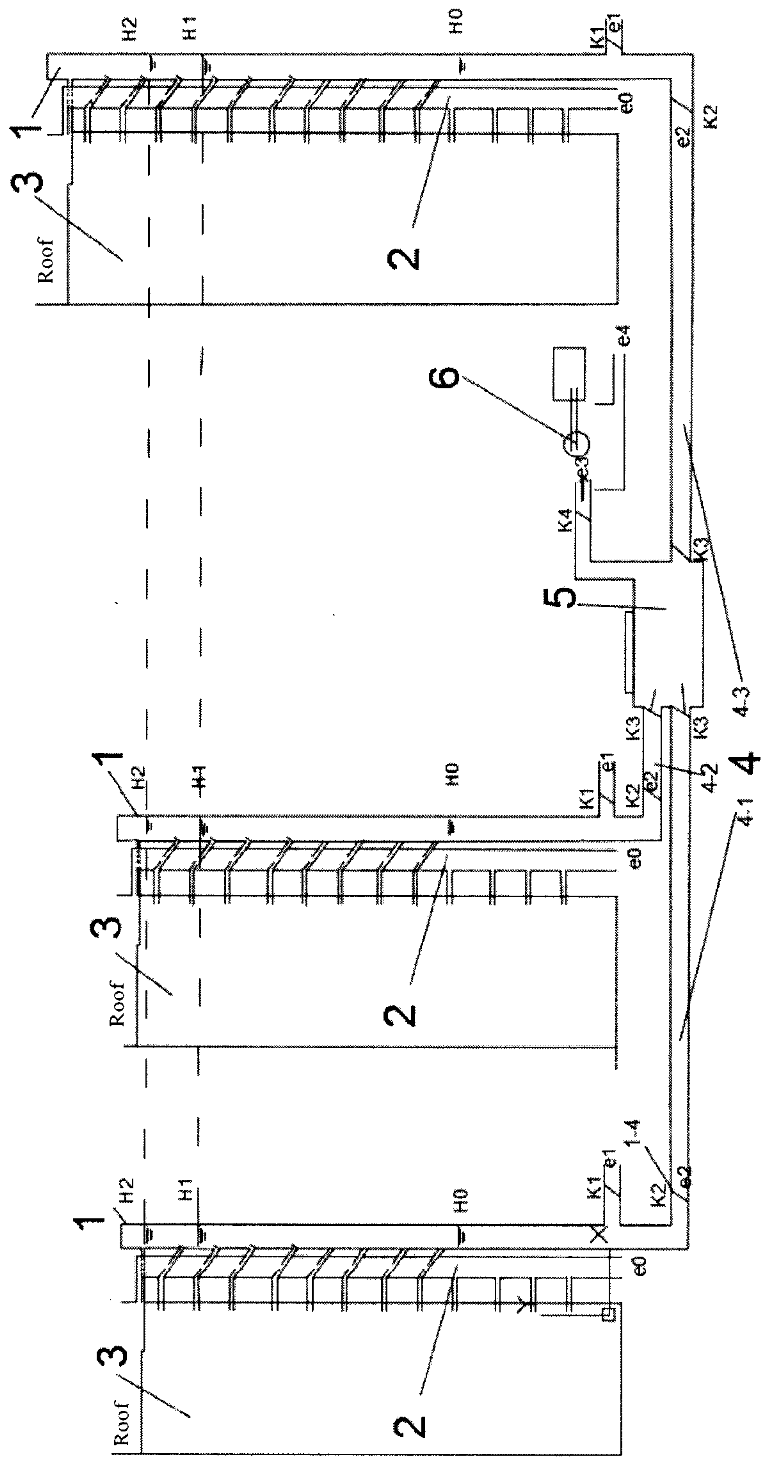

FIG. 1

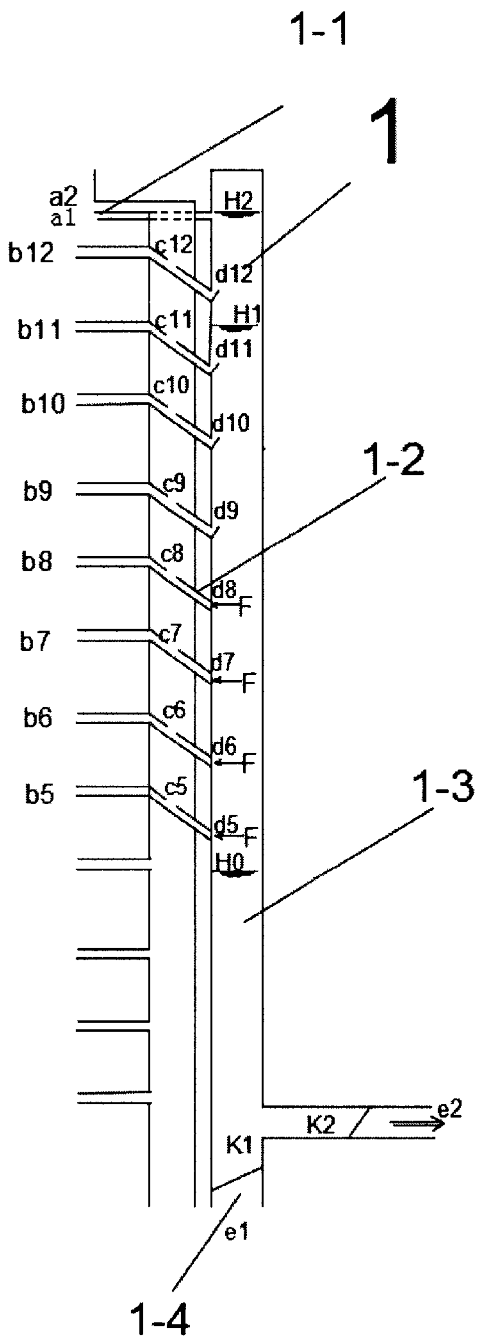
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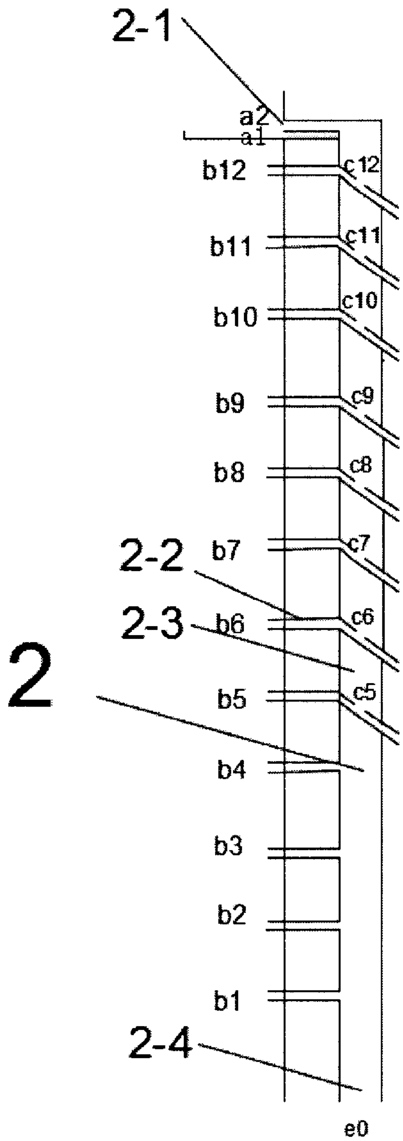
FIG. 2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2-4
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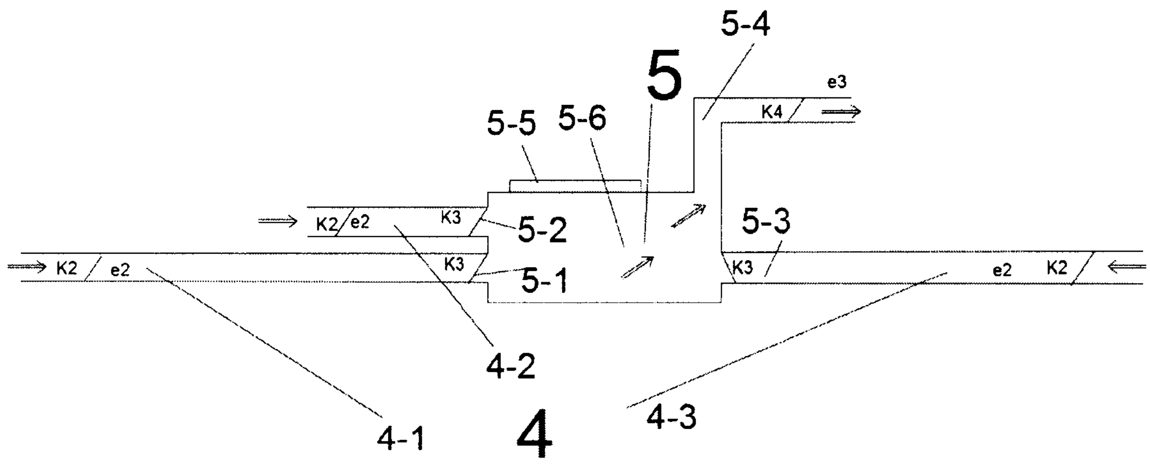
FIG. 3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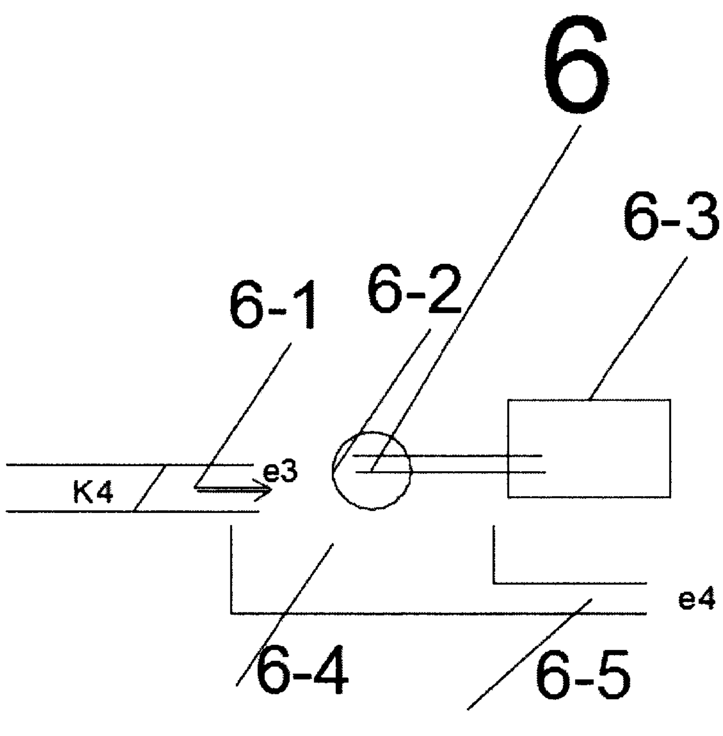
4-1
4

FIG. 4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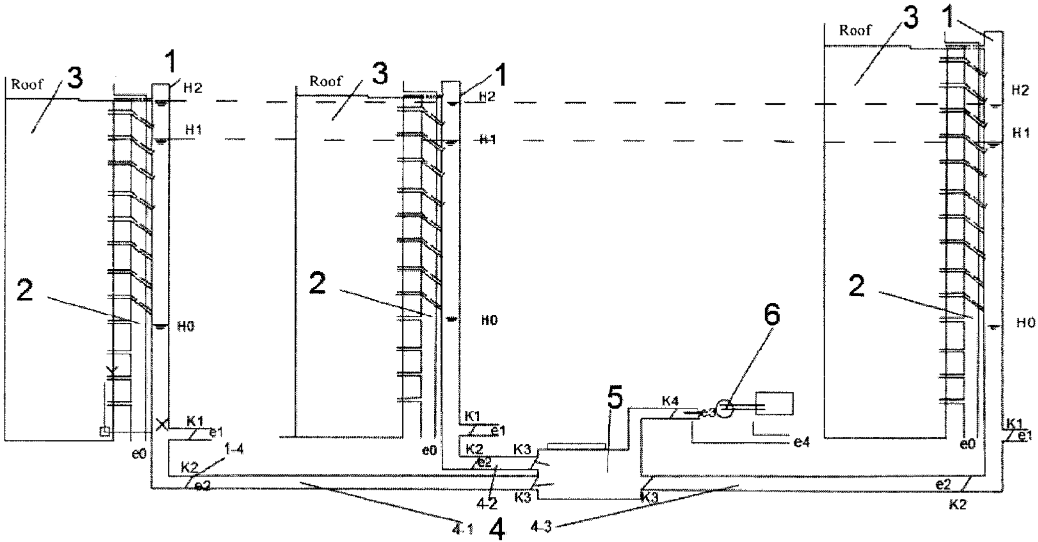
6-5

FIG. 5



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H2
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