A HYDRO-ENERGY CAPTURE SYSTEM

TECHNICAL FIELD

This invention relates generally to a hydropower system. Specifically, this invention relates to a hydro-energy capture system.

Background

Energy production and use are issues faced by many countries. The depletion of recoverable fossil fuels has turned attention towards reducing our reliance thereon through renewable energy resources. Renewable energy is energy derived from resources that are regenerative or cannot be depleted which traditionally includes wind, water, and solar energy. Specifically, it is well known that energy present in water has huge potential to be harnessed and used. A well-known fact is that water is about a thousand times denser than air. Therefore, a flowing stream of water or sea swell can yield considerable amounts of energy.

There are many forms of water energy production, or hydropower solutions, including hydroelectric energy production. Hydroelectric energy systems typically refer to large-scale hydroelectric dam systems. Despite the benefits and advantages, hydroelectric solutions are not readily applicable to a smaller water source, for example a residential area or home water source. They are instead directed to production of electricity on a larger scale with heavy, cumbersome and expensive equipment which are prohibitive to, for example, a residential area of a built-up area with reduced space availability. Further, such solutions cannot be implemented on a widespread basis.

There are hydropower solutions that uses electrically-powered pumps to transport water into elevated storage tanks, building energy potential in the process. The energy may be subsequently recovered when required through discharging the water tank. However, such systems are not energy-efficient and will be difficult to implement in smaller facilities with limited electricity supply.

Therefore, there exists a need for a system for addressing issues with capturing hydro-energy, including producing, storing, and utilizing hydropower using a small water source. Potential advantages of the present invention include capture of energy for contemporaneous or later use and the charging or recharging of battery or capacitor-based systems as well as for driving downstream systems such as hydraulic motor-based systems.

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Summary

In accordance with an aspect of the invention, there is disclosed a hydro-energy capture system comprising a first dynamic vessel for containing liquid that defines a first liquid level and for displacement along a first pathway, a first actuator for displacing the first dynamic vessel between a raised position and a lowered position along the first pathway, a second dynamic vessel for containing liquid that defines a second liquid level and for displacement along a second pathway, and a second actuator for displacing the second dynamic vessel between a raised position and a lowered position along the second pathway. The hydro-energy capture system further comprises an actuator coupling for fluid communicating the first actuator to the second actuator and configured such that displacing the first dynamic vessel towards the lowered position along the first pathway causes displacement of the second dynamic vessel towards the raised position along the second pathway and displacing the second dynamic vessel towards the lowered position along the second pathway causes displacement of the first dynamic vessel towards the raised position along the first pathway.

The hydro-energy capture system further comprises a fan assembly formed integral the actuator coupling for capturing flow of fluid therealong and transducing the fluid flow into at least one of electrical energy, mechanical energy and hydraulic energy, a first static vessel in primed fluid communication with the first dynamic vessel and for containing liquid that defines a third liquid level, and a second static vessel in primed fluid communication with the second dynamic vessel and for containing liquid that defines a fourth liquid level. Wherein introducing liquid into the first dynamic vessel displaces the first dynamic vessel towards the lowered position and positions the first liquid level lower than the third liquid level, thereby

causing liquid in the first static vessel to be siphoned into the first dynamic vessel to aid in the displacement of the second dynamic vessel towards the raised position and the siphoning of liquid from the second dynamic vessel into the second static vessel when the second liquid level is positioned higher than the fourth liquid level. A portion of the fluid in the second dynamic vessel may be discharged to an external facility in tandem with and subsequent to the fluid being siphoned into the second static vessel.

It is an object of the invention that the hydro-energy capture system be used in residential and smaller industrial facilities, although also implementable with larger-scale facilities, the liquid introduced into the first dynamic vessel and the second dynamic vessel may be potable water or non-potable water. Hence, the water discharged from the second dynamic vessel may be supplied to for use in the industrial and residential facilities.

Conversely, it is desirous that introducing liquid into the second dynamic vessel through the second port displaces the second dynamic vessel towards the lowered position and positions the second liquid level lower than the fourth liquid level, thereby causing liquid in the second static vessel to be siphoned into the second dynamic vessel to aid in the displacement of the first dynamic vessel towards the raised position and the siphoning of liquid from the first dynamic vessel into the second static vessel when the first liquid level is positioned higher than the third liquid level. At least a portion of the liquid in the first dynamic vessel being discharged through the first port when the first liquid level is positioned higher than the third liquid level. The liquid discharged from the first port may be harvested, for example, as potable water.

It is an object of the invention that the fan assembly comprises at least one hydro-fan for one of transducing and conveying the at least one of electrical energy, mechanical energy and hydraulic energy from the movement between the first actuator and the second actuator to a downstream system. Such downstream systems may include, but are not limited to a hydraulic energy capture system for utilizing the at least one of electrical energy and

mechanical energy and an energy storage module for storing the electrical energy received from the fan assembly.

Ideally, in order for the natural principles of Bernoulli's equilibrium and siphon principles to work in the hydro-energy capture system, it is preferred that the first static vessel is disposed at a height that is between the raised position and the lowered position of the first dynamic vessel along the first pathway, and the second static vessel is disposed at a height that is between the raised position and the lowered position of the second dynamic vessel along the second pathway.

Further, as the hydro-energy capture system substantially relies on natural principles to function, the hydro-energy capture system can minimally function without or with very little control system interventions. However, to improve or sustain operational efficiency and to allow for operations monitoring and maintenance scheduling, a controller or control system may be implemented to orchestrate the monitoring, data collection and flow intervention within the hydro-energy capture system through the use of valves, transducers and sensors.

As such, it is a further object of the invention that hydro-energy capture system further comprise a first distribution valve formed integral with the first port for controlling flow of liquid between a water source and the first dynamic vessel through the first port, a second distribution valve formed integral with the second port for controlling flow of liquid between the water source and the second dynamic vessel through the second port, and a controller in communication with and for controlling operation of the first distribution valve and the second distribution valve.

The controller is further implemented with at least one first sensor in communication with the controller for enabling position of the first dynamic vessel along the first pathway to be determined, and at least one second sensor in communication with the controller for enabling position of the second dynamic vessel along the second pathway to be determined.

Additionally or alternatively, the controller may be further implemented with a plurality of load cell modules for measuring weight of at least one of the first dynamic vessel, the first static vessel, the second dynamic vessel and the second static vessel and level sensors disposed within each of the first dynamic vessel, the first static vessel, the second dynamic vessel and the second static vessel for sensing liquid level therein.

Brief Description of the Drawings

FIG. 1 shows an exemplary system diagram of a hydro-energy capture system in accordance with an aspect of the invention with a first dynamic vessel in a raised position and a second dynamic vessel in a lowered position;

FIG. 2 shows an exemplary system diagram of the hydro-energy capture system of FIG. with the first dynamic vessel in a lowered position and the second dynamic vessel in a raised position;

FIG. 3 shows an exemplary sectional view of a fan assembly of the hydro-energy capture system of FIG. 1 with hydro-fans coupled to a downstream system;

FIG. 4 shows an exemplary sectional view of a fan assembly of the hydro-energy capture system of FIG. 1 with hydro-fans coupled to an energy storage module and a hydraulic drive system constitution the downstream system;

FIG. 5 shows an exemplary sectional view of a fan assembly of the hydro-energy capture system of FIG. 1 with a bi-directional hydro-fan coupled to a downstream system; and

FIG. 6 shows a system diagram of a controller of the hydro-energy capture system of FIG. 1.

Detailed Description

An exemplary embodiment of the present invention, a hydro-energy capture system 20, is described hereinafter with reference to FIG. 1 and FIG. 6. The hydro-energy capture system 20 comprises a first dynamic vessel 22 for containing liquid that defines a first liquid level 24 and for displacement along a first pathway 26, and a first actuator 28 for displacing the first dynamic vessel 22 between a raised position 30a and a lowered position 30b along the first pathway 26. The hydro-energy capture system 20 further comprises a second dynamic vessel 32 for containing liquid that defines a second liquid level 34 and for displacement along a second pathway 36, and a second actuator 38 for displacing the second dynamic vessel 32 between a raised position 40a and a lowered position 40b along the second pathway 36.

The hydro-energy capture system 20 further comprises an actuator coupling 42 for fluid communicating the first actuator 28 to the second actuator 38 and configured such that displacing the first dynamic vessel 22 towards the lowered position 30b along the first pathway 26 causes displacement of the second dynamic vessel 32 towards the raised position 40a along the second pathway 36 and displacing the second dynamic vessel 32 towards the lowered position 40b along the second pathway 36 causes displacement of the first dynamic vessel 22 towards the raised position 30a along the first pathway 26.

Preferably, the actuator coupling 42 is for communicating hydraulic fluid between the first actuator 28 and the second actuator 38 for effecting actuation thereof. The hydro-energy capture system 20 further comprises a fan assembly 44 formed integral the actuator coupling 42 for capturing flow of fluid therealong and transducing the fluid flow into at least one of electrical energy and mechanical energy for provision as one or both of mechanical power and electrical power. Each of the first actuator 28 and the second actuator 38 can be a hydraulic jack, a hydraulic cylinder or a telescopic hydraulic cylinder. Although it is preferred that the first actuator 28 and the second actuator 38 are single acting cylinders, double acting cylinders may also utilized and adapted for the purpose of enabling the hydro-energy capture system 20.

The hydro-energy capture system 20 further comprises a first static vessel 46 in primed fluid communication with the first dynamic vessel 22 and for containing liquid that defines a third liquid level 48 and a second static vessel 50 in primed fluid communication with the second dynamic vessel 32 and for containing liquid that defines a fourth liquid level 52. Preferably, each of the first static vessel 46 and the second static vessel is spatially immobile with pre-determined positions.

Preferably, the hydro-energy capture system 20 further comprises a first port 54 coupled to the first dynamic vessel 22 for introducing liquid thereinto and for the discharge of liquid therefrom, and a second port 56 coupled to the second dynamic vessel 32 wherethrough at least a portion of the liquid in the second dynamic vessel 32 is discharged when the second liquid level 34 is positioned higher than the fourth liquid level 52. Liquid is also introducible into the second dynamic vessel 32 through the second port 56. Each of the first port 54 and the second port 56 is adaptable for coupling with an external tubing, pipe or conduit.

For illustration, the hydro-energy capture system 20 may start off with the first dynamic vessel 22 in the raised position 30a and the second dynamic vessel 32 in the lowered position 40b as shown in FIG. 1. The aforementioned configuration of the hydro-energy capture system 20 is such that fundamentally, introducing liquid into the first dynamic vessel 22 will displace the first dynamic vessel 22 towards the lowered position 30b, resulting in the first liquid level 24 being positioned lower than the third liquid level 48, thereby causing liquid in the first static vessel 46 to be siphoned into the first dynamic vessel 22 to aid in the displacement of the second dynamic vessel 32 towards the raised position 40a. Liquid siphoned from the first static vessel 46 into the first dynamic vessel 22 acts as a booster to increase the mass of the liquid contained in the first dynamic vessel 22 to thereby displace the second dynamic vessel 32 towards the raised position 40a in order to achieve Bernoulli's equilibrium between the first actuator 28 and the second actuator 38, as shown in FIG. 2.

Displacement of the second dynamic vessel 32 towards the raised position 40a causes the second liquid level 34 to be positioned higher than the fourth liquid level 52 thereby resulting in the siphoning of liquid from the second dynamic vessel 32 into the second static vessel 50. The siphoning of liquid from the second dynamic vessel 32 into the second static vessel 50 reduces the mass of the liquid contained in the second dynamic vessel 32 to thereby further aid in displacement of the second dynamic vessel 32 towards the raised position 40a. At least a portion of the liquid in the second dynamic vessel 32 is discharged therefrom through the second port 56 when the second liquid level 34 is positioned higher than the fourth liquid level 52.

Displacement of the first dynamic vessel 22 towards the lowered position 30b and displacement of the second dynamic vessel 32 towards the raised position 40a stops when mass being supported at the first actuator 28 including mass of the first dynamic vessel 22 and mass of the liquid contained in the first dynamic vessel 22 and the mass of pressure head in the first actuator 28, when normalized with effective piston area of the first actuator 28 substantially matches the mass being supported at the second actuator 38 including mass of the second dynamic vessel 32 and mass of the liquid contained in the second dynamic vessel 32 and the mass of pressure head in the second actuator 38, when normalized with effective piston area of the second actuator 38.

Conversely, introducing liquid into the second dynamic vessel 32 through the second port 56 displaces the second dynamic vessel 32 towards the lowered position 40b and positions the second liquid level 34 lower than the fourth liquid level 52. By virtue of siphon principle, this causes liquid in the second static vessel 50 to be siphoned from the second static vessel 50 into the second dynamic vessel 32 to increase the mass of the liquid contained in the second dynamic vessel 32 to thereby aid in the displacement of the first dynamic vessel 22 towards the raised position 30a. As the first dynamic vessel 22 displaces towards the raised position 30a, as shown in FIG. 1, the first liquid level 24 is positioned higher than the third liquid level 48. This causes the liquid from the first dynamic vessel 22 to be siphoned therefrom into the first static vessel 46. At least a portion of the liquid in the first dynamic

vessel 22 is discharged therefrom through the first port 54 when the first liquid level 24 is positioned higher than the third liquid level 48.

Referring to both FIGS. 1 and 2, the hydro-energy capture system 20 further comprises a first connector tube 58 extending between for fluid communicating the first dynamic vessel 22 and the first static vessel 46. The first connector tube 58 has one extremity disposed adjacent a lower portion of a internal space 60 defined by the first dynamic vessel 22 and another extremity disposed adjacent a lower portion of an internal space 62 defined by the first static vessel 46. The hydro-energy capture system 20 further comprises a second connector tube 64 extending between for fluid communicating the second dynamic vessel 32 and the second static vessel 50, the second connector tube 64 having one extremity disposed adjacent a lower portion of an internal space 66 defined by the second dynamic vessel 32 and another extremity disposed adjacent a lower portion of an internal space 68 defined by the second static vessel 50. Each of the first dynamic vessel 22, the second dynamic vessel 32, the first static vessel 48 and the second static vessel 50 can be made from any material, for example wood, concrete, metal, plastic or any combination thereof, for enabling a water-sealed construction of the respective internal space 62/64/66/68 for containment of liquid therewithin. It is preferred that at least a portion of each of the first connector tube 58 and the second connector tube 58 one or more of is structurally flexible, has a telescopic construction and is swivel-jointed to accommodate the displacement of the first dynamic vessel 22 and the second dynamic vessel 32 and to enable the first connector tube 58 and the second connector tube 58 to maintain priming.

To enable control and, when required, overriding of the flow between the first dynamic vessel 22 and the first static vessel 46 and between the second dynamic vessel 32 and the second static vessel 50 via siphon action, the hydro-energy capture system 20 further comprises a first connector valve 70 formed integral the first connector tube 58 for controlling communication of liquid between the first dynamic vessel 22 and the first static vessel 46, and a second connector valve 72 formed integral the second connector tube 64 for

controlling communication of liquid between the second dynamic vessel 32 and the second static vessel 50.

The hydro-energy capture system 20 further comprises a first guide rail assembly for defining the first pathway 26 and a second guide rail assembly for defining the second pathway 36. Each of the first guide rail assembly and the second guide rail assembly can comprise two or more guide rails arranged parallel to each other to isolate travel of the respective one of the first dynamic vessel 22 and the second dynamic vessel 32 therealong to substantially along a single axis. The two or more guide rails may be disposed in a shaft way formed in natural rock structures, in man-made structures, for example reinforced concrete structures, or in a truss mast. The first actuator 28 and the second actuator 38 are preferably disposed at the base of the shaft way for supporting the respective one of the first dynamic vessel 22 and the second dynamic vessel 32.

Preferably, the hydro-energy capture system 20 can be constructed within a support structure 77 made from reinforced concrete with a height of between eight (8) meters to fifteen (15) meters and with an equally small footprint requirement. This smaller structural requirement of the hydro-energy capture system 20, compared to a hydroelectric dam, makes it easier to construct, has far less financing commitments and risks, can be implemented in built-up/urban areas and is ideal for residential or light industrial facilities with increased viability for wide-scale implementation. A person skilled in the art will appreciate that the dimensions of the hydro-energy capture system 20 may be scaled up or down based on operational requirements without affecting the functionality thereof.

The first static vessel 46 is disposed at a height that is between the raised position 30a and the lowered position 30b of the first dynamic vessel 22 along the first pathway 26, and the second static vessel 50 is disposed at a height that is between the raised position 40a and the lowered position 40b of the second dynamic vessel 32 along the second pathway 36. This being said, each of the first static vessel 46 and the second static vessel 50 is disposed at a

fixed height and spatial position. Further preferably, the first static vessel 46 is disposed at the same height as the second static vessel 50.

Preferably, each of the first actuator 28 and the second actuator 38 is a hydraulic telescopic actuator, and the actuator coupling 42 being at least one of a hydraulic hose and a hydraulic conduit for communicating hydraulic fluid between the first actuator 28 and the second actuator 38.

Generally, the fan assembly 44 can comprise at least one hydro-fan, as illustrated in FIG. 3. Specifically, the fan assembly 44 comprises a first passage 78 having a first check valve 80 to enable flow of liquid in a direction from the first actuator 28 to the second actuator 38 and to substantially impede flow of the liquid in a direction from the second actuator 38 to the first actuator 28 therethrough and a first hydro-fan 82 integrated with the first passage 78 for capturing flow of the liquid from the first actuator 28 to the second actuator 38. Further specifically, the fan assembly 44 also comprises a second passage 84 having a second check valve 86 to enable flow of liquid in a direction from the second actuator 38 to the first actuator 28 and to substantially impede flow of the liquid in a direction from the first actuator 28 to the second actuator 38 therethrough, and a second hydro-fan 88 integrated with the second passage 84 for capturing flow of the liquid from the second actuator 38 to the first actuator 28.

Preferably, each of the first hydro-fan 82 and the second hydro-fan 88 comprises a generator 90 for generating electrical energy from the flow of liquid. Each of the first hydro-fan 82 and the second hydro-fan 88 comprises at least one of an impeller and a plurality of blades for capturing and converting the flow of liquid between the first actuator 28 and the second actuator 38 into rotary motion. Alternatively, the generator 90 is formed external to the fan assembly 44 with the first hydro-fan 82 and the second hydro-fan 88 being one of mechanically and hydraulically coupled thereto for driving the generator 90 to thereby generate electrical energy as shown in FIG. 4.

Alternatively, and with reference to FIG. 5, the fan assembly 44 comprises one flow passage 91a with a hydro-fan 91b, preferably a bi-directional hydro-fan, disposed therewith for capturing flow of the liquid from the first actuator 28 to the second actuator 38, as well as for capturing flow of the liquid from the second actuator 38 to the first actuator 28. The hydro-fan 91b can comprise a generator 91c for generating electrical energy from the flow of liquid. Alternatively, the generator 91c is formed external to the fan assembly 44 with the hydro-fan 91b being one of mechanically and hydraulically coupled thereto for driving the generator 91b to thereby generate electrical energy as shown in FIG. 6.

With reference to FIG. 4, the hydro-energy capture system 20 preferably comprises a downstream system 92 whereto the at least one of electrical energy, mechanical energy and hydraulic energy one of transduced and conveyed by the fan assembly 44 is providable. Preferably, the downstream system 92 is a hydraulic energy capture system, for example a hydraulic drive system 93a or a hydraulic pump of the hydraulic drive system, for utilizing the at least one of electrical energy, mechanical energy and hydraulic energy. Additionally or alternatively, the downstream system 92 comprising an energy storage module 93b, for example one or more batteries or capacitors, for storing the electrical energy received from the fan assembly 44.

In one implementation of the hydro-energy capture system 20, the hydro-energy capture system 20 further comprises a first feed pipe 93 and a first distribution valve 94 formed integral with one of the first feed pipe 93 and the first port 54 for controlling flow of liquid between a water source 96 and the first dynamic vessel 22 through the first port 54. The first feed pipe 93 inter-couples the water source 96 and the first port 54. The hydro-energy capture system 20 further comprises a second feed pipe 97 and a second distribution valve 98 formed integral with one of the second feed pipe 97 and the second port 56 for controlling flow of liquid between the water source 96 and the second dynamic vessel 32 through the second port 56. The second feed pipe 97 inter-couple for fluid communicating the water source 96 and the second port 56.

The water source 96 may be derived from, for example, the water supply to or the water discharge from built-up/urban areas and residential/industrial facilities. Further examples of water source 96 can include the rainwater collection system.

With reference to FIG. 6, the hydro-energy capture system further comprises a controller 100 in communication with and for controlling operation of the first distribution valve 94 and the second distribution valve 98. The controller 100 can be one or a combination of programmable logic controller (PLC), programmable integrated circuit (PIC) or a hard-wired circuit board controller with a communication module for one of wired and wireless signal and data communication therewith.

The water source 96 may provide fluid in the form of potable water or non-potable water. Due to the nature of the hydro-energy capture system 20, the water provided at the water source need not be pressurized or have pressure head potential. Further, flow rate and inertia of water is secondary as the provided water, or fluid, is accumulated at the respective one of the first dynamic vessel 22 and the second dynamic vessel 32 allowing siphon action to draw, and remove, water from the first static vessel 46 and the second static vessel 50 to assist in the ascending displacement and corresponding descending displacement of the respective one of the first dynamic vessel 22 and the second dynamic vessel 32. The need to achieve Bernoulli's equilibrium also triggers the balancing actuation between the first actuator 28 and the second actuator 38, thereby hydraulically actuating the fan assembly 44 for the production and capturing of mechanical energy, in the form of hydraulic energy, and if required, electrical energy.

The first connector valve 70 and the second connector valve 72 can be in signal communication with for control by the controller 100. Each of the first distribution valve 94 and the second distribution valve 98 may be solenoid valves that are controllable by the controller 100 to terminate or distribute liquid from the water source 96 to the first dynamic vessel 22 and the second dynamic vessel 32. Alternatively, each of the first distribution valve 94 and the second distribution valve 98 may be mechanically controlled, for example

through gears, cable, linkages or any combination thereof, to alternate distribution of liquid between the first dynamic vessel 22 and the second dynamic vessel 32 based on absolute or relative positions of the first dynamic vessel 22 and the second dynamic vessel 32, back-pressure at one or both of the first port 54 and the second port 56, or through a pre-determined duration or cyclical period.

The hydro-energy capture system 20 further comprises at least one first sensor 102 in communication with the controller 100 for enabling position of the first dynamic vessel 22 along the first pathway 26 to be determined, and at least one second sensor 104 in communication with the controller 100 for enabling position of the second dynamic vessel 32 along the second pathway 36 to be determined. The at least one first sensor 102 and the at least one second sensor 104 will enable the controller 100 to determine whether one of the first dynamic vessel 22 and the second dynamic vessel 32 have reached their respective raised positions 30a/40a and that liquid from the water source 96 should now be directed to the other of the first dynamic vessel 22 and the second dynamic vessel 32.

Further, the hydro-energy capture system 20 comprises a plurality of load cell modules 106 in signal communication with the controller 100 for measuring weight of at least one of the first dynamic vessel 22, the first static vessel 46, the second dynamic vessel 32 and the second static vessel 50 independently. Each of the first dynamic vessel 22, the first static vessel 46, the second dynamic vessel 32 and the second static vessel 50 comprising a level sensor 108 disposed therein and in signal communication with the controller 100 for sensing liquid level therein. The plurality of load cell modules 106 and the level sensor 108 may be used independently to replace the at least one first sensor 102 and the at least one second sensor 104 or be used in combination with the at least one first sensor 102 and the at least one second sensor 104 in determine the extent that the respective one of the first dynamic vessel 22 and the second dynamic vessel 32 has been filled for determining where the liquid from the water source may be further directed 96. Additionally, the plurality of load cell modules 106 and the level sensor 108 may be used collaboratively with the at least one first sensor 102 and the at least one second sensor 104 to detect presence of fault of operational issues

with the hydro-energy capture system 20. For example, an increase in liquid level within and weight of the first dynamic vessel 22 which is met with no or slow displacement of the first dynamic vessel 22 could be indicative of defects or problems with the first guide rail assembly or first actuator 28, which may initiate a maintenance task before the problems further propagates to other parts of the hydro-energy capture system 20.

Data obtained from the plurality of load cell modules 106, the level sensor 108 the at least one first sensor 102 and the at least one second sensor 104 may be used for data analytics to better improve operational efficiency and efficacy of the hydro-energy capture system 20.

The level sensor 108 of one or more of the first dynamic vessel 22, the first static vessel 46, the second dynamic vessel 32 and the second static vessel 50 can form internal ballast float sensor switch arrangement (not shown) where an internally disposed float ballast in one or more of the first dynamic vessel 22, the first static vessel 46, the second dynamic vessel 32 are coupled to a lever switch, for example a rocking lever-type switch, for mechanically or electro-mechanically determining one or more of the first liquid level 24, the second liquid level 34, the third liquid level 48 and the fourth liquid level 52. This enables and controls, for example, switching of the first distribution valve 94 and the second distribution valve 98 to redirect fluid received from the water source 96 from the first dynamic vessel 22 and to second dynamic vessel 32 when the first dynamic vessel 22 has been fully filled, and from the second dynamic vessel 32 to the first dynamic vessel 22 when the second dynamic vessel has been fully filled. When electro-mechanically operated, the lever switch is preferably signal coupled to the controller 100.

Aspects of particular embodiments of the present disclosure address at least one aspect, problem, limitation, and/or disadvantage associated with existing hydro-energy capture systems. While features, aspects, and/or advantages associated with certain embodiments have been described in the disclosure, other embodiments may also exhibit such features, aspects, and/or advantages, and not all embodiments need necessarily exhibit such features, aspects, and/or advantages to fall within the scope of the disclosure. It will be appreciated by

a person of ordinary skill in the art that several of the above-disclosed structures, components, or alternatives thereof, can be desirably combined into alternative structures, components, and/or applications. In addition, various modifications, alterations, and/or improvements may be made to various embodiments that are disclosed by a person of ordinary skill in the art within the scope of the present disclosure, which is limited only by the following claims.

Claims

1. A hydro-energy capture system comprising:

a first dynamic vessel for containing liquid that defines a first liquid level and for displacement along a first pathway;

a first actuator for displacing the first dynamic vessel between a raised position and a lowered position along the first pathway;

a second dynamic vessel for containing liquid that defines a second liquid level and for displacement along a second pathway;

a second actuator for displacing the second dynamic vessel between a raised position and a lowered position along the second pathway;

an actuator coupling for fluid communicating the first actuator to the second actuator and configured such that displacing the first dynamic vessel towards the lowered position along the first pathway causes displacement of the second dynamic vessel towards the raised position along the second pathway and displacing the second dynamic vessel towards the lowered position along the second pathway causes displacement of the first dynamic vessel towards the raised position along the first pathway;

a fan assembly formed integral the actuator coupling for capturing flow of fluid therealong and transducing the fluid flow into at least one of electrical energy, mechanical energy and hydraulic energy;

a first static vessel in primed fluid communication with the first dynamic vessel and for containing liquid that defines a third liquid level; and

a second static vessel in primed fluid communication with the second dynamic vessel and for containing liquid that defines a fourth liquid level,

wherein introducing liquid into the first dynamic vessel displaces the first dynamic vessel towards the lowered position and positions the first liquid level lower than the third liquid level, thereby causing liquid in the first static vessel to be siphoned into the first dynamic vessel to aid in the displacement of the second dynamic vessel towards the raised position and the siphoning of liquid from the

second dynamic vessel into the second static vessel when the second liquid level is positioned higher than the fourth liquid level.

2. The hydro-energy capture system as in claim 1, further comprising

a first port coupled to the first dynamic vessel for introducing liquid thereinto; and

a second port coupled to the second dynamic vessel wherethrough at least a portion of the liquid in the second dynamic vessel is discharged when the second liquid level is positioned higher than the fourth liquid level.

3. The hydro-energy capture system as in claim 2, wherein introducing liquid into the second dynamic vessel through the second port displaces the second dynamic vessel towards the lowered position and positions the second liquid level lower than the fourth liquid level, thereby causing liquid in the second static vessel to be siphoned into the second dynamic vessel to aid in the displacement of the first dynamic vessel towards the raised position and the siphoning of liquid from the first dynamic vessel into the second static vessel when the first liquid level is positioned higher than the third liquid level, at least a portion of the liquid in the first dynamic vessel being discharged through the first port when the first liquid level is positioned higher than the third liquid level.

4. The hydro-energy capture system as in claim 1, the fan assembly comprising at least one hydro-fan.

5. The hydro-energy capture system as in claim 1, the fan assembly comprising:

a first passage having a first check valve to enable flow of liquid in a direction from the first actuator to the second actuator and to substantially impede flow of the liquid in a direction from the second actuator to the first actuator therethrough;

a first hydro-fan integrated with the first passage for capturing flow of the liquid from the first actuator to the second actuator;

a second passage having a second check valve to enable flow of liquid in a direction from the second actuator to the first actuator and to substantially impede flow of the liquid in a direction from the first actuator to the second actuator therethrough; and

a second hydro-fan integrated with the second passage for capturing flow of the liquid from the second actuator to the first actuator.

6. The hydro-energy capture system as in claim 5, each of the first hydro-fan and the second hydro-fan comprising a generator for generating electrical energy from the flow of liquid.

7. The hydro-energy capture system as in claim 5, each of the first hydro-fan and the second hydro-fan comprising:

at least one of an impeller and a plurality of blades for capturing and converting the flow of liquid between the first actuator and the second actuator into rotary motion.

8. The hydro-energy capture system as in claim 1, further comprising:

a downstream system whereto the at least one of electrical energy, mechanical energy and hydraulic energy one of transduced and conveyed by the fan assembly is providable.

9. The hydro-energy capture system as in claim 8, the downstream system being a hydraulic energy capture system for utilizing the at least one of electrical energy, mechanical energy and hydraulic energy.

10. The hydro-energy capture system as in claim 8, the downstream system comprising an energy storage module for storing the electrical energy received from the fan assembly.

11. The hydro-energy capture system as in claim 2, further comprising:

a first distribution valve formed integral with the first port for controlling flow of liquid between a water source and the first dynamic vessel through the first port;

a second distribution valve formed integral with the second port for controlling flow of liquid between the water source and the second dynamic vessel through the second port; and

a controller in communication with and for controlling operation of the first distribution valve and the second distribution valve.

12. The hydro-energy capture system as in claim 11, further comprising:

at least one first sensor in communication with the controller for enabling position of the first dynamic vessel along the first pathway to be determined; and

at least one second sensor in communication with the controller for enabling position of the second dynamic vessel along the second pathway to be determined.

13. The hydro-energy capture system as in claim 1, further comprising:

a first connector tube extending between for fluid communicating the first dynamic vessel and the first static vessel, the first connector tube having one extremity disposed adjacent a lower portion of an internal space defined by the first dynamic vessel and another extremity disposed adjacent a lower portion of an internal space defined by the first static vessel; and

a second connector tube extending between for fluid communicating the second dynamic vessel and the second static vessel, the second connector tube having one extremity disposed adjacent a lower portion of an internal space defined by the second dynamic vessel and another extremity disposed adjacent a lower portion of an internal space defined by the second static vessel.

14. The hydro-energy capture system as in claim 13, further comprising:

a first connector valve formed integral the first connector tube for controlling communication of liquid between the first dynamic vessel and the first static vessel; and

a second connector valve formed integral the second connector tube for controlling communication of liquid between the second dynamic vessel and the second static vessel.

15. The hydro-energy capture system as in claim 1, further comprising:

a first guide rail assembly for defining the first pathway; and

a second guide rail assembly for defining the second pathway.

16. The hydro-energy capture system as in claim 1, further comprising:

a plurality of load cell modules for measuring weight of at least one of the first dynamic vessel, the first static vessel, the second dynamic vessel and the second static vessel.

17. The hydro-energy capture system as in claim 1, each of the first dynamic vessel, the first static vessel, the second dynamic vessel and the second static vessel comprising a level sensor for sensing liquid level therein.

18. The hydro-energy capture system as in claim 1, the first static vessel is disposed at a height that is between the raised position and the lowered position of the first dynamic vessel along the first pathway, and the second static vessel is disposed at a height that is between the raised position and the lowered position of the second dynamic vessel along the second pathway.

19. The hydro-energy capture system as in claim 1, each of the first actuator and the second actuator being a hydraulic telescopic actuator, and the actuator coupling being at least one of a hydraulic hose and a hydraulic conduit for communicating hydraulic fluid between the first actuator and the second actuator.