

Hydroelectric Inflow Dam System

Field of Invention

[0001] The present invention relates to a hydroelectric dam system. In particular, the invention relates to hydroelectric power generating system by channeling hydraulic inflow from a body of water into a hollow channel.

Background

[0002] Renewable “green” power technologies are increasingly being sought as they are the key to creating a clean and green energy for the future. These renewable energy sources such as solar, wind and water are also natural resources. Water or hydro power is the largest source of clean and green electricity; it accounts for about 20% of all electricity produced globally and the technology involved is proven.

[0003] These hydroelectric plants are usual huge and involve a lot of investments. There is therefore a need to extract the potential energy of a smaller body of stored or running water to generate a clean source of electricity.

Summary

[0004] The following presents a simplified summary to provide a basic understanding of the present invention. This summary is not an extensive overview of the invention, and is not intended to identify key features of the invention. Rather, it is to present some of the inventive concepts of this invention in a generalised form as a prelude to the detailed description that is to follow.

[0005] The present invention seeks to provide a system for exploiting the potential energy of a body of water to generate electricity. In another embodiment, the present invention provides a hydroelectric system. The system comprises: a body of water; an in-flow dam built in the body of water, with said inflow dam having an internal cavity and walls of the in-flow dam have nozzles; a sleeve surrounding an external surface of the inflow dam, wherein the sleeve has apertures that correspond to the nozzles to control water flow through the nozzles; a turbine disposed inside the internal cavity of the inflow dam so that the turbine is rotatable by water flowing through the nozzles; a generator connectable to the turbine; and a

discharge channel for discharging water flow downstream of the turbine; wherein the in-flow dam is supported by a base, in which the discharge channel is formed.

[0006] In an embodiment of the hydroelectric system, the inflow dam is higher than the highest water level and water flows into the internal cavity of the inflow dam through nozzles so that kinetic energy of the water jets shaped by the nozzles is imparted to rotate the turbine and generator to generate electricity. In one embodiment, the inflow dam is submerged in the body of water. In another embodiment, the nozzles form one or more rows of nozzles disposed on the circumference of the inflow dam and the number of rows of nozzles correspond with the number of turbines or impellers of the turbine. In yet another embodiment, impellers of the turbine are elongate and are substantially parallel or spiral to the axis of rotation of the turbine; one or more water jets shaped by the nozzles are operable to impinge on an elongate impeller.

[0007] In another embodiment, the present invention provides a hydroelectric system comprising: a body of water; an inflow dam built in the water, with the in-flow dam having an internal cavity; a sleeve surrounding an external surface of the inflow dam; a turbine disposed inside the internal cavity of the inflow dam; a generator connectable to the turbine; and a discharge channel for discharging water flow downstream of the turbine; wherein the inflow dam is supported by a base, in which the discharge channel is formed and an upper part of the inflow dam is lower than a low water level so that water flows over the sleeve into the internal cavity of the inflow dam and the dynamic pressure and flow of water are operable to rotate the turbine and generator to generate electricity.

[0008] In one embodiment of the hydroelectric system, an external surface of the inflow dam is surrounded by a sleeve, with said sleeve having apertures that correspond to the nozzles to control water flow through the nozzles. In one embodiment, the sleeve is rotatable about the inflow dam; in another embodiment, the sleeve is axially slidable on the inflow dam to control flow rate of inflow water according to a water head above the sleeve.

[0009] In another embodiment of the hydroelectric system, the top of the inflow dam is closed by a detachable cover and a valve plate disposed on the cover.

Brief Description of the Drawings

[0010] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

[0011] FIG. 1A illustrates a cross-section of an in-flow dam for use with a turbine according to an embodiment of the present invention;

[0012] FIG. 1B illustrates an inflow dam with two rows of nozzles for use with a turbine having two rows of impellers according to another embodiment of the present invention;

[0013] FIGs. 1C and 1D illustrate a cross-section of an inflow dam for use with a turbine having elongate impellers;

[0014] FIG. 2 illustrates a cross-section of an inflow dam for use with a turbine according to another embodiment of the present invention; and

[0015] FIG. 3 illustrates a system of inflow dams according to yet another embodiment of the present invention.

Detailed Description

[0016] One or more specific and alternative embodiments of the present invention will now be described with reference to the attached drawings. It shall be apparent to one skilled in the art, however, that this invention may be practised without such specific details. Some of the details may not be described at length so as not to obscure the invention. For ease of reference, common reference numerals or series of numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0017] FIG. 1A shows a system **10** using a turbine **50** to generate hydro-electricity according to an embodiment of the present invention. As shown in FIG. 1, the system **10** is made up of a body of water **20**, for example being stored behind an embankment **22**. An inflow dam **30** having an internal cavity **32** is built in the body of water **20**. The inflow dam **30** is built higher than the highest water level but the walls of the inflow dam **30** are formed with nozzles **40** so that jets of water flow from outside the inflow dam **30** into the internal cavity **32** and the kinetic energy in the water jets is imparted to the impellers of the turbine **50** for rotating the turbine. The turbine **50** is connected to a

generator **60** through a drive shaft **52** and, where necessary, a gear system **54**. The water downstream of the turbine flows into a discharge channel **70** and then into a discharge pipe **80** before the water is discharged to a lower ground.

[0018] In a variation, as shown in FIG. 1B, of the above embodiment, the nozzles **40** are disposed on two or more circumferential rows around the inflow dam **30**. The number of rows of nozzles **40** correspond with the number of turbines **50**.

[0019] FIG. 1C shows a system **10a** to generate hydro-electricity according to another embodiment of the present invention. The system **10a** is similar to that of system **10** and the same series of reference numerals are used for similar elements; for example, **40a,40b** etc refer to the nozzles, and **50a** refers the turbine. As shown in FIG. 1C, the impellers of the turbine **50a** are elongate and substantially parallel or spiral about the axis of rotation of the turbine, and two or more jets of water are operable to impart kinetic energy to each impeller of the turbine **50a**. In a variation, as shown in FIG. 1D, the nozzles **40a** are also elongate and they generate water jets with elongate cross-sectional area to impart kinetic energy to each elongate impeller of the turbine **50a**.

[0020] In one embodiment, the inflow dam **30** shown in FIGs. 1A-1D is circular in its external dimension. As shown in FIG. 1A, the inflow dam **30** has a shoulder **34** around the inflow dam and a rotatable sleeve **36** supported on the shoulder **34**. The shoulder **34** is located below the nozzle **40,40a** and the sleeve **36** has a number of apertures **37** corresponding to the number of nozzles **40,40a** so that the apertures **37** and nozzles **40,40a** are in register. On the inflow dam **30** and surrounding each nozzle **40,40a** is a seal **38**. The sleeve **36** is rotatable, for example, by means of a fluid cylinder. When the apertures **37** are not in register with the nozzles **40,40a**, water is prevented from flowing through the nozzles, for example, during maintenance of the hydro-electricity system **10,10a**. In a variation, the inflow dam **30** does not have the shoulder but the upper end of the sleeve **36** has a flange **39** that is supported on the top edge of the inflow dam **30**.

[0021] In another embodiment, the inflow dam **30** shown in FIGs. 1A-1D is non-circular in its external dimension. The external of the inflow dam **30** and the sleeve **36** may be

square or polygonal. In this embodiment, the sleeve **36** is slidable on the external surface of the inflow dam **30**, for example by means of a fluid cylinder **90**, as shown in FIG. 1B.

[0022] FIG. 2 shows a system **100** using a turbine **150** to generate hydro-electricity according to another embodiment of the present invention. As in the previous system **10**, the system **100** also has a body of water **20**, for example being stored behind an embankment **22**. The system **100** includes an inflow dam **130** being built in the body of water, for example, below a low water level and the internal cavity **132** of the inflow dam is operable to be filled with water. Located inside a lower part of the cavity **132** is the turbine **150**. The turbine **150** is connected to a generator **60** by a shaft **152**, and where necessary, through a gear system **154**. Preferably, the generator **60** is disposed above the highest water level. Due to gravity, water flows through the turbine **150**; the dynamic pressure and hydraulic flow turn the impellers of the turbine **150**. The mechanical energy of the turbine **150** is then converted to electricity in the generator **60**. The discharge channel **70** after the turbine acts like a draft tube and it helps create suction at the discharge channel **70**, thereby increasing the dynamic hydraulic flow and head across the turbine **150** and the electricity output from the generator **60**.

[0023] As in the previous embodiments, a sleeve **136** is provided around the inflow dam **130**. In one embodiment, the sleeve **136** is operable to extend above the top end of the inflow dam **130** so that water is prevented from entering the inflow dam **130**, for example during maintenance. A seal **138** may be provided between the sleeve and the external surface of the inflow dam **130**. In use, a fluid cylinder **90** may control the sleeve **136** for regulating the head and amount of water flow to the turbine **150**.

[0024] FIG. 3 shows another hydro-electricity system **200** according to yet another embodiment of the present invention. The system **200** comprises of a network of the above systems **10**, **10a**, **100**. The hydro-electric system **200** allows a user to select a number of the above systems **10,10a,100** to operate according to the electricity demand and available water head/hydraulic flow. This allows some of the inflow dams **30,130** to be closed, for example, for maintenance without disrupting the supply of electricity from the hydro-electric system **200**.

[0025] Known hydro-electric power plants are usually very large and they involve huge capital investments. They also tend to affect the local ecology once the dams associated with the hydro-electric plants are flooded. The present systems **10, 10a, 100, 200** provide another hydroelectric generating system that makes use an existing body of water; they may supply hundreds of kilowatt, if not megawatts, for example, to supplement an existing hydroelectric power plant. It is possible that the present systems **10,10a,100,200** are planned for a future body of water. The body of water may be part of a reservoir, a lake or a sea for storing water, flood control and/or irrigation.

[0026] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the invention. For example, the body of water may be a lake, reservoir or a river. In another example, the inflow dam may be formed as a unit separate from the discharge pipe but are modularly connected, for example, by means of bolts and nuts. In yet another example, the inflow dams need not be open at the top; in FIGs. 1A-1D, the inflow dams may be submerged, with the top of the inflow dams being closed, for example by a detachable cover, and water flows in through the nozzles at the side of the inflow dams; in FIG. 2, the inflow dams may similarly be submerged, with the top being closed by a detachable cover but has apertures for water flow into the inflow dam; a valve plate with apertures corresponding to those on the cover is rotatable to control water flow into the inflow dam. It is also possible that a hybrid turbine of those shown in FIGs. 1A-1D and 2 be used and nozzles are accordingly provided on the sides and top of the inflow dams.

CLAIMS:

1. A hydroelectric system comprising:
 - a body of water;
 - an in-flow dam built in the body of water, with said inflow dam having an internal cavity and walls of the in-flow dam have nozzles;
 - a sleeve surrounding an external surface of the inflow dam, wherein the sleeve has apertures that correspond to the nozzles to control water flow through the nozzles;
 - a turbine disposed inside the internal cavity of the inflow dam so that the turbine is rotatable by water flowing through the nozzles;
 - a generator connectable to the turbine; and
 - a discharge channel for discharging water flow downstream of the turbine;
 - wherein the in-flow dam is supported by a base, in which the discharge channel is formed.
2. A hydroelectric system according to claim 1, wherein an upper part of the inflow dam is higher than the highest water level and water flows into the internal cavity of the inflow dam through the nozzles so that kinetic energy of the water jets shaped by the nozzles is imparted to rotate the turbine and generator to generate electricity.
3. A hydroelectric system according to claim 1, wherein the inflow dam is submerged in the body of water and water flows into the internal cavity of the inflow dam through the nozzles so that kinetic energy of the water jets shaped by the nozzles is imparted to rotate the turbine and generator.
4. A hydroelectric system according to claim 2 or 3, wherein the nozzles form one or more rows of nozzles and the number of rows of nozzles correspond with the number of turbines.
5. A hydroelectric system according to claim 2 or 3, wherein impellers of the turbine have predetermined surface area, which are substantially parallel or spiral to the axis of rotation of the turbine.
6. A hydroelectric system according to claim 5, wherein two or more rows of water jets impinge on each impeller of the turbine.

7. A hydroelectric system according to claim 5, wherein the nozzles are elongate in cross-sectional area and each jet of water is operable to impinge on each impeller of the turbine.
8. A hydroelectric system according to any one of the preceding claims, wherein a seal is disposed between the sleeve and the external surface of the inflow dam to stop water flow into the inflow dam when the apertures are not in register with the nozzles.
9. A hydroelectric system according to any one of the preceding claims, wherein the external of the inflow dam is circular and the sleeve is rotatable about the inflow dam.
10. A hydroelectric system according to any one of claims 1-8, wherein the external of the inflow dam is non-circular and the sleeve is axially slidable on the inflow dam.
11. A hydroelectric system comprising:
 - a body of water;
 - an in-flow dam built in the water, with the in-flow dam having an internal cavity;
 - a sleeve surrounding an external surface of the inflow dam;
 - a turbine disposed inside the internal cavity of the in-flow dam;
 - a generator connectable to the turbine; and
 - a discharge channel for discharging water flow downstream of the turbine;wherein the in-flow dam is supported by a base, in which the discharge channel is formed and an upper part of the inflow dam is lower than a low water level so that water flows over the sleeve into the internal cavity of the inflow dam and the dynamic pressure and flow of water are operable to rotate the turbine and generator to generate electricity.
12. A hydroelectric system according to claim 11, wherein the sleeve is slidable on the inflow dam to control flow rate of inflow water according to a water head above the sleeve.

13. A hydroelectric system according to claim 11 or 12, wherein a top of the inflow dam is open but is covered by a detachable cover, with the detachable cover having apertures for water to flow into the inflow dam.
14. A hydroelectric system according to claim 13, wherein a valve plate is disposed on the cover for controlling water flow through apertures on the valve plate and those on the cover.
15. A hydroelectric system according to claim 14, wherein the valve plate is rotatable on the cover.
16. A hydroelectric system according to any one of the preceding claims, wherein the inflow dam and base are formed as separate modules but are connected for fluid communication.
17. A hydroelectric system according to any one of claims 1-16, wherein the external surface of the in-flow dam comprises a shoulder for supporting the sleeve.
18. A hydroelectric system according to any one of claims 1-16, wherein a top of the sleeve comprises a flange for engaging with a top of the in-flow dam.
19. A hydroelectric system comprising a network of the systems according to any one of claims 1-18.