MICRO POWER PLANT

The present invention relates to a device for the generation of hydropower, and more specifically, the present invention relates to a micropower plant for converting kinetic energy from flowing fluids, such as water, into electrical power.

There are known devices and/or systems that use solar or wind to generate electric power. A disadvantage of such devices and/or systems is that the power generation depends on weather conditions at the place where the device and/or the system is deployed; at night or in cloudy weather, little or no solar energy will be generated, similarly in the absence of a wind or during heavy wind, no wind energy will be generated.

A disadvantage of such devices and / or systems would be that consumers or end users are not guaranteed a continuous power supply, so energy must be stored to ensure energy supply during periods when electrical power generation is not possible.

Another disadvantage of wind power plants is that they can cause "noise pollution" and that they to a greater or lesser degree disfigure the landscape.

Furthermore, installation of wind power plants offshore requires high investment in connection with installation and maintenance. Transmission of generated energy to land will also be expensive, as the laying of cables over large distances will often be requested, over large distances, where said cables further must be of considerable size in order to transmit the generated energy satisfactorily.

Alternative devices and/or systems utilizing a water flow in order to generate energy are also known, such as, for example, hydroelectric power plants. Such hydroelectric power plants require the creation of reservoirs in rivers using one or more intake ponds. To achieve maximum energy production in the hydroelectric power plant, the location of each intake pond must be carefully chosen, as not all rivers and/or water systems are suitable for such hydroelectric power plants.

The water reservoirs may also have harmful effects on the environmental nature, disturbing natural habitats for aquatic animals and plants.

Creating such reservoirs may also result in the loss of large land areas, leaving land area under water, causing villages and/or towns to be moved and reservoirs can also constitute a risk in the case of failure in the intake pond.

Such hydroelectric power plants and intake ponds are large and complex structures, so the construction of such an installation is an expensive, long lasting and complex matter.

The present invention seeks to provide an alternative power plant for converting kinetic energy into electrical current which remedies disadvantages of the prior art, and which at the same time is compact and consists of few parts.

This object is achieved according to the present invention by the features set forth in the following independent claims, wherein further features of the invention are evident from the dependent claims and the description below.

The present invention relates to a micro power plant for converting kinetic energy from flowing fluid into electrical power, wherein the micro power plant is suitably connected to or arranged on a support structure and comprises a propeller including a hub and a plurality of propeller blades connected to the hub, and an electric power converter. The propeller and the electric power converter are connected to one another by a driving device, a first guiding means for the driving device being arranged around a largest outer circumference of the propeller blades and a second guiding means for the driving device arranged on an input shaft of the electric power converter, where a largest diameter of the hub is between 35% and 90% of a largest diameter of the propeller.

More preferably, the largest diameter of the hub is between 45% and 80% of the largest diameter of the propeller. Even more preferably the largest diameter of the hub is between 55% and 70% of the largest diameter of the propeller.

In one embodiment of the present invention, the hub may be designed to form a closed and sealed body thus forming a buoyancy member for the propeller when the propeller is placed in a body of water. By adjusting this buoyancy to the propeller weight, the propeller will be able to be completely or partially immersed in a body of water. The hub may also be designed with a ballast device, so as to further adjust or control the propeller's immersed state in the body of water.

A driving device for the micro power plant may be one or more endless chains, one or more endless belts or the like.

The flowing fluid may, for example, be water. It should be understood, however, that the micro power plant according to the present invention may also be used as a wind power plant.

Through the above design of the micro power plant, the water flowing over the propeller blades will cause them to rotate, where this rotation is transferred to the electric power converter through the driving device, and where the electrical converter will thereafter generate electrical power.

The propeller may in one embodiment comprise six propeller blades, where the propeller blades are arranged with an equal distance between them and around an outer circumference of the hub, but it should be understood that the number of propeller blades may be both greater or fewer than six.

In one embodiment, each propeller blade may be formed with a constant pitch over its axial extent, where a flange or break member may further be connected to a tip of each propeller blade. The flanges or break members will form a support and be attachment points for the first guiding means of the driving device and will further result in more water accumulating and passing over the propeller when the propeller, for example, is only partially immersed in water. Each flange or break member is arranged to form an angle with the propeller blade to which it is connected, where this angle, for example, may be between 75 degrees and 105 degrees. The flange or break member will further follow the curve of the propeller blade over the entire tip.

Each propeller blade may furthermore extend substantially over the entire axial length of the hub, i.e. from a forward end of the hub and to a rear end of the hub when the hub is seen in an axial cross section.

The design of the propeller blades and flanges or break members will also cause these to act as "spikes" for the driving device.

The first guiding means may be connected to the propeller blades and the flanges or break members, where the first guiding means may be attached at any point along the curvature of the tip, but is preferably arranged and connected to these at a forward end of the tip when viewed in an axial cross section of the propeller.

In an embodiment of the micro power plant, a third guiding means for the driving is arranged between the first and second guiding means of the driving device which is arranged on the propeller and the input shaft of the electric power converter, respectively, where the third guiding means of the driving device may comprise an outer structure provided with a through-going opening, where a pulley, a wheel or the like is arranged on opposite sides of the outer structure and further arranged to extend in towards a center of the through-going opening. By arranging the pulleys or wheels at a distance between them, the driving device may be guided through the third guiding means of the driving device, so as to narrow or constrict the driving device over the third guiding device. If the driving device is in the form of an endless chain or an endless belt, a guiding over and around the largest outer diameter of the propeller blades will cause a distance between an inside of the endless chain or endless belt to be large. This distance must be reduced to bring the endless chain or endless belt around the second guiding means of the driving device which is arranged on the input shaft of the electrical converter, as the second guiding means is much smaller than the first guiding means of the driving device. The lead-through of the driving device through the third guiding means will then cause the distance between the inside of the endless chain or endless belt to become smaller so as to prevent slipping or "jumping" of the endless chain or endless belt, and furthermore holding the endless chain or the endless the belt correctly "centered" in relation to the first and second guiding means so that the endless chain or endless belt does not "jump out" of these.

The narrowing to which the endless chain or endless belt is subjected upon passage through the third guiding means will also cause the endless chain or endless belt to be in contact with a larger surface or a larger portion of a circumference of the first guiding means of the driving device, whereby this will create a greater friction between the first guiding means and the driving device.

The micro power plant may, in one embodiment, include a chain or belt tensioner to reduce or dampen «jumping» of the chain or belt. A person skilled in the art will know how to design and arrange such a chain or belt tensioner and is thus not described further herein.

The first and second guiding means of the at least one driving device may be in the form of a ring, where the ring may be designed to have a substantially U-shaped form, but it may also be envisaged that the ring may be designed to have other shapes, for example a V-shape or the like. In an alternative embodiment, the first and second guiding means of the driving device may be configured as an annular gear.

In one embodiment, a friction element may be provided between the endless chain or the endless belt and the ring (guiding means), thus providing a further friction against the endless chain or endless belt. The friction element may further be arranged over the entire or parts of a circumference of the ring. In one embodiment, the friction element may be of rubber or materials which possess similar properties.

The micro power plant may be designed to store the converted kinetic energy from the flowing fluid as current on at least one battery, or transmit the power to a supply system. The at least one battery and/or the supply system can then be connected to the electric power converter in suitable ways through one or more power lines.

If the micro power plant, for example, is to be used in a water system, a river or the like, the support structure may comprise a base or foundation designed to be connected to a ground on which the micro power plant is to be placed, a first beam which is pivotally connected to the base or foundation about a vertical axis, where a second beam is further pivotally connected to the first beam about a horizontal axis, and a third beam which is connected to one end of the second beam. Through this design, the second beam could be used to lower or raise the propeller in the water, while the first beam will be used to turn the propeller out to water or to land for maintenance, repair and the like. The propeller will then be connected to the third beam through the hub and a rotatable shaft.

In order to prevent the micro power plant from rotating about the vertical axis when the micro power plant is in use and the propeller is arranged in the water system or the river, such that the propeller is forced out of the water and up on land, the micro power plant is anchored upstream of the propeller, where one or more wires, chains or the like then will be connected to the third beam.

If the micro power plant according to the present invention is used as a wind power plant, the support structure will comprise a vertical mast which may also comprise a number of anchoring elements in the form of chains, wires or beams. One skilled in the art will know how such a support structure is to be designed and connected to the micro power plant, and thus no further description is given herein.

In order to decrease the resistance of the propeller in water, a terminating cone may be connected to the hub so as to provide a hydrodynamic body, where this has a drop-shaped form. However, one skilled in the art will know that other forms than a cone can be used to achieve the hydrodynamic properties of the hub, whereby this is not described further herein.

The driving device may, as stated above, consist of an endless chain, an endless belt or an annular gearing. The skilled person will further appreciate that multiple endless chains, endless belts or annular gearings may be used as driving devices.

The electric converter may be a generator, but it may also be a water pump or the like.

Further objects, constructive embodiments and advantages of the present invention will become apparent from the following detailed description, the accompanying figures and the following claims.

The invention will now be explained with reference to the accompanying drawings in which:

Figure 1 shows a first embodiment of a micro power plant according to the present invention, seen in a perspective view partly from behind, where the micro power plant is arranged in a river or stream,

Figure 2 shows the micro power plant according to figure 1, viewed in a perspective view partly from the front,

Figure 3 shows the micro power plant according to figure 2 in a perspective view partly from the front and from an opposite side of figure 3,

Figure 4 shows the micro power plant according to figure 1 viewed from above, and

Figure 5 shows a guiding means for a driving device according to the present invention in greater detail and in a cross-section.

Figures 1-4 show an embodiment of a micro power plant 1 for converting kinetic energy from flowing fluid to electric power according to the present invention, where the micro power plant 1 is arranged in a water system, in a stream or in a river. The micro power plant 1 for converting kinetic energy from flowing fluid to electric power comprises a propeller 3 comprising a hub 4 and a plurality of propeller blades 5 which are suitably connected to the hub 4, where the micro power plant 1 further comprises an electric power converter 6 through which at least one driving device is connected to the propeller 3. A first guiding device 8 will then be arranged around a largest outer diameter D of the propeller blades 5, while a second guiding means 10 will be arranged on an input shaft of the electric power converter 6. Each of the first and second guiding means 8, 10 will, in this case, be designed to have a U-shape, or also be formed with a groove around its entire circumference when viewed in cross-section, such that the driving device 7, which in this case is constituted by an endless belt, is laid in and around a circumference of the first and second guiding means.

Each of the six propeller blades 5 connected to the hub 4 is formed with a constant pitch over its axial extent, where a flange or break member 9 is connected to the tip of the propeller blade 5. The flanges or break members 9 will form a support and be attachment parts for the first guiding means 8.

The flange or break member 9 forms an angle with the propeller blade 5 to which it is connected to, where this angle is between 75 degrees and 105 degrees.

The first guiding means 8 is further preferably connected to propeller blade 5 and flange or break member 9 at a forward end of the tip of the propeller blade 5. The design of the propeller blades 5 and flanges 9 will cause them to act as "spikes" for the first guiding means of the driving device 7.

The propeller 3 is connected to a support structure 2, where the support structure 2 in this case comprises a base or foundation 2A which is designed to be anchored to a ground G on which the micro power plant 1 is to be mounted. A sleeve 2B is pivotally connected to the base or foundation 2A, where a first beam 2C is pivotally connected to the sleeve 2B. The sleeve 2B will be rotatable about a vertical axis extending through the base or foundation 2A, while the first beam 2C will be rotatable about a horizontal axis extending perpendicular to the vertical axis, causing the propeller 3 to swing between a position on land and a position in water, and further that the position of the propeller 3 in the water can be adjusted by raising or lowering the first beam 2C.

A second beam 2D is connected to one end of the first beam 2C, extending downwardly from the first beam 2C, where the hub 4 is rotatably connected to the second beam 2D through a shaft 13 which is suitably connected to the second beam 2D.

The second beam 2D is further formed with an attachment device 18 for one or more wires, chains (not shown) or the like, for anchoring the micro power plant upstream thereof, such that the micro power plant is not rotated about the vertical axis due to the forces propeller 3 is exposed to when it is in the body of water.

By means of devices (not shown) arranged on the support structure 2, the propeller 3 will be able to be maintained in a desired position in the water, where this position may be partially submerged or completely submerged. The devices may consist of any adjustment and locking devices which allows the first beam 2D to move relative to the sleeve 2B and then be locked in a position in relation to the sleeve 2B.

A third guiding device 11 for the at least one driving device 7 is connected to the second beam 2C, where the third guiding means 11 comprises an outer structure 11B with a centrally located through-going hole, where a pulley 11A is arranged on each and opposite side of the outer structure 11B, and where each pulley 11A further extends toward a center of the through-going hole. However, the pulleys 11A will not extend completely to the center, but be spaced apart so that the endless belt 7 can be guided through the through-going hole in the outer structure 11B and further between the pulleys 11A. T lead-through of the endless belt 7 through the outer structure 11B and the two pulleys 11A will result in that the endless belt 7 in this case will be narrowed together. The third guiding means 11 will ensure that the endless belt 7 to a lesser degree, is allowed to have a slack and further cause the endless belt 7 to be properly centered relative to the first and second guiding means 8,10 so that the endless belt 7 does not hop off these.

Moreover, the narrowing of the endless chain or endless belt 7 which is achieved by lead-through of the endless chain or endless belt 7 through the third guiding means 11, will result in that the endless chain or endless belt 7 is brought into contact with a larger part of the circumference of the first and second guiding means 8, 10, thus providing a greater friction between the endless chain or endless belt 7 and guiding means 8, 10, such that a much greater portion of the rotational energy of the propeller 3 can be transmitted to the electric converter 6.

The micro power plant 1 also includes a chain or belt tensioner (not shown) to reduce "jumping" of the chain or belt during operation of the micro power plant 1, such that the chain or belt 7 does not jump off the first and/or second guiding means 8, 10.

The micro power plant 1 according to the present invention is formed with a relatively large hub 4, where a largest diameter d of hub 4 will be between 35% and 90% of a largest diameter D of the propeller 3.

More preferably, the largest diameter d of the hub 4 can be between 45% and 80% of the largest diameter D of the propeller 3, even more preferably, the largest diameter d of hub 4 may be between 55% and 70% of the largest diameter D of propellers 3.

Through such a design of hub 4 and propeller blade 5, the water above the propeller 3 will gain acceleration and local velocity increase while local pressure decreases. This pressure reduction causes the water to concentrate or gather around the hub 4. As a result, the kinetic energy of a free current of the water will gather around the area of the propeller blades 5 and thus more of this energy can be utilized.

The hub 4 is designed to form a closed and sealed body, such that the hub 4 can be used as a float or buoyancy body for propeller 3 when it is in the water. In this way, the hub 4 can be arranged to keep the propeller 3 fully or partially immersed in the body of water.

The electrical converter 6 is suitably connected to two batteries 12 through feed lines (not shown) so that the converted kinetic energy from the flowing fluid can be stored as current on these.

In figure 5, the first and second guiding means 8, 10 and the endless chain or endless belt 7 are shown in greater detail and in a cross-section showing that the first and second guiding means 8, 10 in the form of a ring are formed with a contact surface 13 for the endless chain or endless belt 7 and two upwardly extending flanges 14, thus forming a substantially U-shaped ring.

In order to increase the friction between the endless chain or the endless belt 7 and the first and second guiding means 8, 10 in the form of the ring 8, 10, there is provided a friction element 15 between the endless chain or the endless belt and the first and second guiding means 8, 10 in the form of the ring 8, 10, in which the friction member 15 is suitably connected to the contact surface 13, around all or parts of the circumference of the ring.

The micro power plant 1 according to the present invention may also be used to utilize kinetic energy from tides and/or ocean streams.

The present invention has now been explained with reference to embodiments, but a person skilled in the art will appreciate that changes and modifications of these embodiments may be made, which fall within the scope of the invention as defined in the following claims.

CLAIMS

1. A micro power plant (1) for converting kinetic energy from flowing fluid to electric power, which micro power plant (1) is connected to a support structure (2) and comprises a propeller (3) comprising a hub (4) and a plurality of propeller blades 5) connected to the hub (4), where the micro power plant (1) further comprises an electric power converter (6) characterized in that the propeller (3) and the electric power converter (6) are connected through at least one driving device (7), a first guiding means (8) of the at least one driving device (7) is arranged around a largest outer circumference of the propeller blades (5) and a second guiding means (10) for the at least one driving device (7) is arranged on an input shaft of the electric power converter (6) and where a largest diameter (d) of the hub (4) is between 35% and 90% of a largest diameter (D) of the propeller (3), where each propeller blade (5) is formed with a constant pitch over its axial extent and where a flange (9) is connected to a tip of each propeller blade (5).

2. A micro power plant (1) according to claim 1, characterized in that each propeller blade (5) extends substantially over the entire axial length of the hub (4) from one side to the opposite side, when viewed in an axial cross section of the hub 4).

3. Micro power plant according to claim 1, characterized in that a third guiding means (11) for the at least one drive device (7) comprises an outer structure (11B) having a through-going opening, where a pulley (11A) on each side of the outer structure 11B) is arranged to extend towards a center of the through-going opening, where the pulleys (11A) further form a spacing between them, such that the at least one drive device (7) can be lead through the third guiding means (11).

4. Micro power plant (1) according to one or more of the preceding claims, characterized in that one or more batteries (12) are in suitable ways connected to the electric power converter (6).

5. Micro power plant (1) according to one or more of the preceding claims, characterized in that the support structure (2) comprises a base (2A), a first beam (2B) pivotally connected to the base (2A) about a vertical axis, a second beam (2C) pivotally connected to the first beam (2B) about a horizontal axis and a third beam (2D) connected to one end of the second beam (2C), the hub (4) being rotatably connected to the third the beam (2D) through the shaft (13).

6. Micro power plant (1) according to one or more of the preceding claims, characterized in that a closing cone is connected to the hub (4).

7. A micro power plant (1) according to claim 1, characterized in that the driving device (7) is an endless chain, an endless belt or an annular gearing.

8. A micro power plant according to one or more of the preceding claims, characterized in that the electrical converter (6) is a generator.

9. A micro power plant (1) according to claim 8, characterized in that the generator is connected to a motor (6).

10. A micro power plant (1) according to claim 8, characterized in that the generator is arranged in the hub (4).

11. Micro power plant (1) according to claim 6, characterized in that at least one rudder is arranged at one end of the closing cone.

12. Micro power plant (1) according to claim 1, characterized in that the first and second guiding means (8, 10) comprises a ring.

13. Micro power plant (1) according to claim 12, characterized in that the ring (8, 10) comprises a contact surface (13) for the driving device (7) and two upwardly extending flanges (14), thus forming a substantially U-shape.

14. Micro power plant (1) according to claim 13, characterized in that a friction element (15) is provided around the entire or parts of the contact surface (13).

15. Micro power plant (1) according to claim 1, characterized in that the first guiding means (8, 10) comprises an annular gearing.

ABSTRACT

The present invention relates to a power plant for transforming kinetic energy from a flowing fluid to electrical power, where the flowing fluid may be water or wind, where the micro power plant is connected to a support structure and comprise a propeller including a hub and a plurality of propeller blades which are in suitable ways connected to the hub, the micro power plant further comprising an electric power converter, and where the propeller and the electric power converter are connected through at least one driving device, a first guiding means for the at least one driving device being arranged around a largest outer circumference of the propeller blades and a second guiding means for the at least one driving device is arranged on an input shaft of the electric power converter and where a largest diameter of the hub is between 35% and 90% of a largest diameter of the propeller.

FIG. 1.