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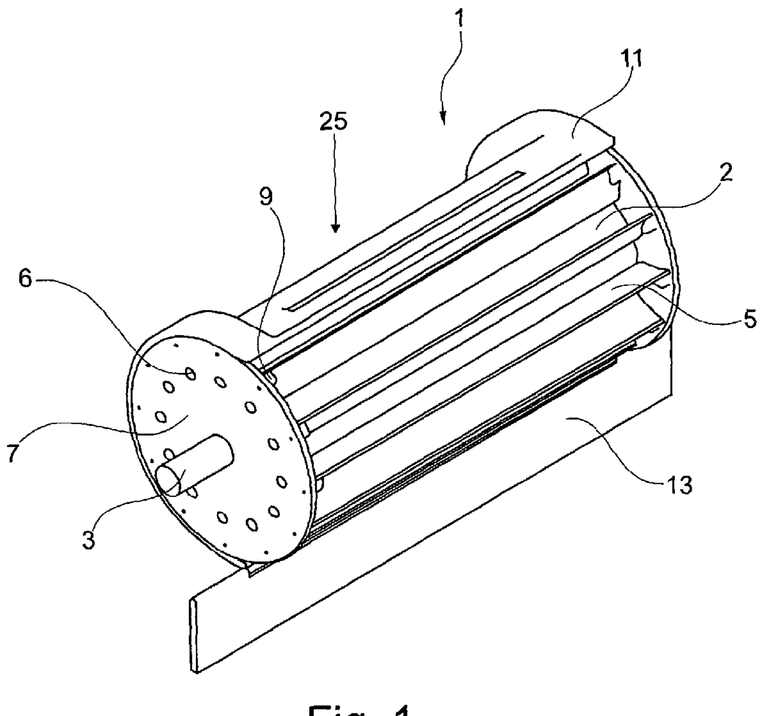

Fig. 1

(57) Abstract: The present invention relates to a turbine apparatus (1) for locating in a fluid in which the fluid flows in at least one direction. The turbine apparatus (1) includes a turbine shaft (3) and a plurality of movable blades (5) that are circumferentially distributed relative to the turbine shaft (3). Each blade (5) is movable from an active configuration to a passive configuration. In an active configuration the blade (5) is oriented to provide a high resistance to fluid flow and in the passive configuration the blade (5) is oriented to provide a low resistance to fluid flow. The turbine assembly (1) also includes blade controlling means (11) adapted to control the orientation of the movable blades (5) between the active configuration and the passive configuration.

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TURBINE APPARATUS

FIELD OF THE INVENTION

The present invention relates to a turbine apparatus. In particular, the invention relates to a turbine that is arranged, in use, to generate electricity by rotational movement caused by flowing water, for example tidal waters and river flows acting on the turbine.

BACKGROUND TO THE INVENTION

An increase in awareness of environmental issues and in knowledge of the types of available renewable energy sources has led to greater activity in the development of electricity generating devices from alternative sources to those such as oil, gas and nuclear.

Renewable energy is energy that comes from natural resources such as wind, sunlight, rain and tides; all of which are naturally occurring in the environment and replenish naturally. Use of such natural sources of energy can supplement and replace large amounts of existing sources of energy while achieving an overall reduction in CO_2 emissions to meet the growing demands of world wide legislation.

It is difficult to maintain a constant and adequate supply of electricity from sources such as wind and sunlight due to uncertainty and inconsistent delivery of the energy source.

Tidal and river flows are known and relatively consistent energy sources that convert energy from fluid flow, for example the sea into electricity, or other useful forms of power. Similarly, river flow can also be used as an energy source that converts energy from the river flow into useful forms of power. River flow and tidal flow are more predictable and consistent than the other renewable energy sources and therefore would appear to offer a superior solution for electricity generation from an environmental and sustainable source.

However, despite certainty in the activity of the sea waters and rivers the capability of generating electricity from such a source is somewhat under exploited.

Examples of devices that use water to generate power and operate by extracting energy from the impulse (momentum) of moving water are conventional water mills and the Pelton wheel. In these cases the turning member of the device is not fully immersed in the water that drives the device and in which the device operates.

Recent technological developments and improvements in turbine technology in the form of axial turbines and crossflow turbines have shown an increase in potential use of the momentum of moving waters such as tides as an energy source.

In its simplest form a turbine includes a rotor assembly comprised of a shaft with blades attached such that the moving tide acts upon the blades and as a reaction to the fluid flow the blades rotate and impart energy to the rotor.

It is desirable to provide an improved marine turbine apparatus that utilises energy from fluid flow, for example river flow or tidal flow, to generate power.

It is also desirable to provide an improved marine turbine apparatus that operates continuously regardless of the direction of tidal flow.

It is further desirable to provide a marine turbine apparatus that can be changed from a power generating configuration to a non-generating configuration.

It is further desirable to provide a turbine that may be mounted from above the sea or fluid surface such that the turbine apparatus may be withdrawn easily for maintenance and repair.

It is further desirable to provide a turbine apparatus that can be connected to a generator, wherein the generator and any electrical connections are located outside of the fluid.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention there is provided a turbine apparatus for locating in a fluid in which fluid flows in at least one direction, wherein the turbine apparatus comprises;-

a turbine shaft; a plurality of movable blades circumferentially distributed relative to the turbine shaft, wherein each blade is movable from an active configuration in which the blade is oriented to provide a high resistance to fluid flow to a passive configuration in which the blade is oriented to provide a low resistance to fluid flow;

a blade controlling means adapted to control orientation of the blades between the active configuration and the passive configuration.

Advantageously, a turbine apparatus according to the first aspect of the invention is operable to rotate the position of the turbine such that the turbine blades face the fluid flow from any direction. Such continuous orientation of all the blades alters according to the direction of fluid flow between an active configuration and a passive configuration.

A blade having an active configuration is one that is initially and substantially normal to the fluid flow and as such presents a high resistance to the fluid flow in which the fluid flow acts against the blade and causes rotation of the blade in the flow direction and also causes the turbine shaft to rotate.

When the orientation of the blade opposes the direction of fluid flow it will take up the passive configuration. A blade having a passive configuration is a blade that’s orientation has been altered such that the blade presents a low resistance to fluid flow where fluid pressure on the blade is at least decreased and does not substantially impede rotation of the blades.

The blade controlling means may alter the orientation of the blades from an active configuration to a passive configuration such that the blades in the passive configuration do not impede rotation of the turbine shaft. By reorientation of the blades, the blade controlling means may change the configuration of the turbine apparatus from a power generating status to a non-generating status.

The blade controlling means may be separate to the blades and may be positioned relative to the blades such that the operation of the blade controlling means is such that the orientation of each blade may change from a passive to an active mode.

The blade controlling means may act upon the blades continuously to operate the turbine shaft.

The blade controlling means may be configured such that it is positioned around the blades such that each blade is movable from a passive configuration to an active configuration substantially continuously to operate the turbine shaft.

The blade controlling means may include a guide member adapted to act upon one or more blades in a direction opposing fluid flow such that the blades are altered from an active configuration to a passive configuration.

The guide member may be integral with or coupled to the blade controlling means, wherein the guide member may be adapted to contact with one or more blades to alter the configuration of the blades from an active configuration to a passive configuration.

The blade controlling means may further comprise a vane arrangement, wherein the vane is coupled to, and may be adjustable with respect to the blade controlling means. Advantageously, the vane can continuously be arranged such that it is parallel to the fluid flow by that flow and will thus maintain the blade controlling means in a stationary position with respect to the turbine shaft and the direction of fluid flow.

Upon rotation of the vane with respect to the blade controlling means the blade controlling means may be rotated with respect to an oncoming fluid flow. Thus the blade controlling means may be adapted to expose a varying amount of each active blade to the oncoming fluid thus varying power absorption.

The vane may be hingedly attached to an edge of the blade controlling means. Alternatively, or in addition, the vane may be adjusted remotely for example by a hydraulic system. Adjustment of the vane may optimise the required position of the blade controlling means relative to fluid flow. The vane may operate through 90 degrees thereby facilitating changing the orientation of the blades from active configuration to a passive configuration.

The blade controlling means may be positioned to surround one or more of the blades. The blade controlling means may be arranged to surround half of the blades. The blade controlling means may be positioned by the vane to protect all of the blades from oncoming flow thereby substantially configuring the turbine apparatus in a non-generating state, thus shutting down the turbine.

The blade controlling means may include a guide member integral with the blade controlling means or coupled thereto. The guide member may include guide rails on an inside surface of the blade controlling means. Alternatively, the guide member may include a profiled inner surface of the blade controlling means. Alternatively, the guide member may be provided by an inside diameter of the blade controlling means that is less than the outside diameter of the turbine apparatus as defined by the blades in an active configuration.

The guide rails, profiled inner surface or the reduced diameter may be adapted to contact one or more of the plurality of blades as the blade controlling means rotates such that the blades move from an active configuration to a passive configuration. The blade controlling means may be rotated up to ninety degrees such that its orientation relative to oncoming fluid flow is adjusted as guided by the vane's orientation relative to the fluid flow.

In an embodiment of the invention the blade controlling means may be a cowling that surrounds one or more of the blades. The cowling may comprise a window portion. The window portion may provide a flow path through the turbine apparatus such that debris and marine life can pass through or around the turbine apparatus during operation.

The movable blades may each be pivotally arranged relative to the turbine shaft.

The turbine apparatus may further comprise a rotational drum comprising at least end flanges located at the longitudinal ends of the drum. At least one end of each blade may be pivotally connected to the flanges. Each end of each blade may be pivotally connected to one of the two flanges.

Additional flanges and additional connection points for each blade may be provided, such that the blades are supported sufficiently for the force of fluid flow. One or each flange may comprise a stop arranged relative to each of the plurality of movable blades to limit the amount of pivotal rotation in one direction of each blade when the blades are in the active configuration.

The drum may act to limit pivotal rotation of the blades in the opposite direction when the blades are in the passive configuration. The stops may provide shock absorption such that the pivotal movement of the blades is controlled.

The turbine apparatus may further comprise a bearing arrangement between the shaft and the blade controlling means such that rotation of the blade controlling means relative to the shaft is substantially unimpeded.

The turbine apparatus may also comprise one or more bearings upon the shaft to support its rotation within a supporting framework.

The turbine apparatus may be configurable between a power generating status and a non generating status.

In a non-generating status, all blades may take up the passive configuration. In one embodiment of the invention, in a non-generating status, the blade controlling means may protect all blades from the fluid flow and all blades may be in a passive mode, where half of the blades may be held in passive mode by the blade controlling means and half of the blades may be oriented relative to the fluid flow such that the fluid flow has no effect on those blades.

The orientation of the blade controlling means may be adjusted remotely, for example, by a hydraulic system.

In the embodiment comprising an adjustable vane the orientation of the vane may also be altered to vary the blade controlling means from a power generating status to a non-generating status. In a generating status the vane may be arranged radially with respect to the blade controlling means and in line with the direction of fluid flow, for example tidal flow. In the power generating configuration, half of the blades may be exposed to the fluid flow and thus arranged in an active configuration. In a non generating status the vane may be arranged circumferentially with respect to the blade controlling means such that the blade controlling means adjusts to assume a passive configuration such that no rotation of the turbine shaft is possible.

In an embodiment of the invention the turbine apparatus is oriented such that the turbine shaft is vertically oriented. The turbine apparatus may be adapted to be held in position by suspension from a structure above the surface of the water in which there is fluid flow. Alternatively or in addition, the turbine may be adapted to be anchored from below.

The turbine assembly may further comprise an output shaft connectable to a generating device. The generating device may be above the surface of the water in which the turbine apparatus is immersed.

Alternatively, the turbine apparatus may be housed in a framework which may be seated on the fluid bed. A generating device may be attachable to the turbine apparatus.

The generating device may be an electrical generator.

The turbine apparatus may be fully immersed in the fluid.

In use, at least a part of the output shaft may be located above the surface of the water in which the turbine apparatus is immersed.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention are further described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic representation of a perspective view of a turbine according to an embodiment of the present invention;

Figure 2 is a diagrammatic representation of a cross sectional view of the turbine assembly of Figure 1 and Figure 3;

Figure 3 is a diagrammatic representation of a cowling used with the turbine of Figure 1;

Figure 4 is a diagrammatic representation of an example application of the turbine as illustrated in Figures 1 to 3;

Figure 5 is a diagrammatic representation of a non-generating configuration of the turbine of Figures 1 to 4; and

Figure 6 is a diagrammatic representation of a cross-sectional view of the turbine assembly of Figure 5.

BRIEF DESCRIPTION

Figure 1 illustrates a turbine assembly 1 in accordance with an embodiment of an invention. The turbine 1 comprises a drum 2 arranged concentrically about a turbine shaft 3. A number of blades 5 are supported at both ends from the flanges 7 such that they project radially from the drum 2 and are evenly distributed around the circumference of the drum 2. In the illustrated embodiment, the length of the drum 2 and the blades 5 is substantially equivalent.

In the illustrated embodiment, each of the blades 5 is arranged to assume one of two configurations or an intermediate/temporary position between those two; an active fluid receiving configuration (indicated by 5AC in figure 2), when the blades 5 project radially from the surface of the drum 2 and a passive configuration (indicated by 5PC in figure 2) when the blades 5 assume a position where they are circumferentially oriented.

In the passive configuration the blades 5 are arranged such that water flows across the blades 5 and not against the blades 5. Fluid flows against the blade 5 only when the blade 5 is in an active configuration such that the blades 5 and the turbine shaft 3 rotate.

The direction of fluid flow is indicated by the arrow 25 in Figures 1 to 5.

Referring to Figure 1, the turbine assembly 1 also comprises two flanges 7 which are arranged at each longitudinal end of the drum 2. Each blade 5 is attached via a pivot 6 to each flange 7 such that the blades 5 can pivot between the active configuration and the passive configuration as described above.

The degree of pivotal movement of each blade 5 is limited in one direction by a stop 9, where the blade 5 is in the active configuration and projects radially from the drum 2 and in the other direction, where the blades 5 are in a passive configuration and rest against the drum 2.

The stop 9 limits the pivotal rotation of the blade 5 and also includes shock absorption to control the pivotal rotation of the blades 5 in the direction of fluid flow.

The turbine assembly 1 further comprises a guide member 11. In the illustrated embodiment the guide member is provided by cowling 11 that is arranged concentrically with the drum 2 and the shaft 3. The cowling 11 rotates relative to the flange 7. The cowling 11 and the shaft 3 are coupled via a suitable bearing unit (not shown) such that rotation of the cowling 11 is substantially unimpeded.

The cowling 11 includes a vane 13 coupled to one edge of the cowling 11. The cowling 11 and vane 13 are arranged such that fluid flow, such as tidal flow, applies a load on the vane 13, which causes the vane 13 to move and the cowling 11 to rotate. The orientation of the vane 13 with respect to the cowling 11 and the oncoming fluid flow ensures that the cowling 11 is continuously aligned with the direction of fluid flow to provide an active configuration, or a passive configuration or any position in between.

Referring to Figure 2, a cross sectional view of the turbine assembly 1 shows the action of the cowling 11 and the blades 5 and the turbine apparatus 1 in an active configuration.

As the cowling 11 is held in position by the vane 13 acting as a rudder the cowling's 11 orientation is adjusted with respect to the fluid flow by means of the position of the vane 13 . The cowling 11 acts against one or more of the blades 5 such that those blades 5 are pushed from the position where they project radially from the drum 2 into a position where the blades 5 rest against the drum 2. In the illustrated embodiment, the cowling 11 causes approximately half the number of blades 5 to be moved to the passive configuration where they rest against the drum 2 and fluid flow, such as tidal flow has little effect on those blades 5 and half the number of blades remain in the active configuration, where fluid flow acts directly on those blades 5, such that the blades 5, the flanges 7 and the turbine shaft 3 rotate. As the blades 5 rotate, those blades 5 in the passive configuration, due to the action of the cowling 11, will revert naturally to the active configuration as they are exposed to fluid flow.

The cowling 11 comprises an inner guide 17. The inner guide 17 is arranged such that, when the drum 2 and turbine blades 5 rotate, those blades 5 moving inside the area of the cowling 11 pivot towards the drum 2. The inner guide 17 may be provided by guide rails on the inside surface of the cowling 11 such that the inner surface of the cowling 11 has a diameter less than the outside diameter of the turbine assembly 1 as defined by the radially projecting blades 5 or the guide rails may define a shape, such as an ellipse, to act on the blades 5 to move them from an active configuration to a passive configuration and return them to an active configuration. Alternatively, the inside of the cowling 11 may include a profiled surface, for example an ellipse or an inside diameter less than the outside diameter of the turbine assembly 1 as defined by the radial projecting blades 5 such that the inside surface of the cowling 11 or at least the leading edge of the cowling 11 acts on the blades 5 to move them from an active configuration to a passive configuration and return them to an active configuration.

Referring to Figure 3, the cowling 11 is arranged with a window portion 15. The window portion 15 provides a flow path through the turbine 1 such that debris and marine life are able to pass over the blades 5 in the passive configuration and exit the turbine 1.

Referring to Figure 4, one application of the turbine assembly 1 is illustrated, where, in operation, the turbine assembly 1 is immersed in, for example sea water, such that tidal flow acts on the vane 13 to continuously align the cowling 11 such that a number of the blades 5 are exposed to tidal flow.

In the example illustrated, the turbine assembly 1 is vertically oriented and the turbine shaft 3 is coupled to a generating device 16 either directly or via an output shaft coupled to the turbine shaft 3.

In use, the upper end of the turbine shaft 3 or the output shaft coupled thereto is clear from contact with the water. The upper end of the turbine shaft 3 or an additional output shaft is connected to a suitable generator 16. The generator 16 can be of any known type. The generator may be connected to an electrical support network.

The generator 16 or generators (where the system comprises more than one turbine apparatus 1) may be housed in a building 19 from which electrical energy could be generated. The building may be an offshore building 19 upon a platform 21 above the sea. The platform 21 may be erected above the sea 23 and may provide an electrical supply network where the electricity is generated from the conversion of tidal energy to electricity. The effect of tidal flow 25 on the blades 5 operates the turbine apparatus 1 as described above with reference to figures 1, 2 and 3 such that the turbine shaft 3 rotates and by suitable connection to a generator tidal energy is converted into electricity. In the arrangement described and illustrated it will be appreciated that generator and electrical connections are in a dry environment.

The building 19 may incorporate an overhead crane (not illustrated) such that any turbine assembly 1 may be retracted easily and regularly from its operating position for maintenance or repair. It will be appreciated that several such turbines 1 may be used together.

As shown in Figure 4, the turbine 1 is arranged with the axis vertically oriented such that tidal flow is normal to the axis of the turbine 1 as shown by the arrows 25. In Figure 4, the turbine assembly 1 is suspended from the platform 21. The turbine 1 may be suspended by a suitable rigid supporting framework (not shown). Alternatively, or in addition the turbine assembly 1 may also be anchored to a suitable foundation depending on the location in which the turbine assembly 1 is deployed. Tethering the turbine assembly 1 by suspension and/or anchoring will ensure the most efficient orientation of the blades 5 relative to the tidal flow.

The blades 5 have a general hydrofoil profile in order to maximise the efficiency of rotation due to the action of tidal flow.

The turbine assembly 1 and generator arrangement 16 described above have many advantages over conventional arrangements because the provision of the pivotal blades 5 increases the efficiency of energy capture. The rotational cowling 11 and the directional vane 13 act together to reduce resistance to flow by removing the effects of the blades 5 that oppose the flow direction. Therefore, the turbine assembly 1 according to the embodiments described above provide certainty for energy conversion regardless of flow direction.

The configuration described above and as illustrated in Figures 1 to 4 represents only one system in a power generating status.

Referring to Figure 5 and Figure 6, the turbine assembly 1 is shown in a non power generating configuration where the turbine assembly 1 is disabled through the vane 13 being positioned circumferentially with respect to the cowling 11 and as such can be retrieved for maintenance and likewise can be simply deployed again when required.

The vane 13 and the blades 5 are arranged such that they can all be altered between a power generating and a non-generating configuration. The vane 13 may be hingedly attached to the cowling 11 such that the variable orientation of the vane 13 acting as a rudder may align the cowling 11 from the active through to the passive configuration.

In Figures 5 and 6, the vane 13 is shown in passive mode. As described above, each blade 5 is pivotally attached to the flanges 7 and each blade 5 can pivot towards the drum 2 by the action of the cowling 11. With the vane 13 in this orientation the cowling 11 remains stationary relative to the blades 5 and none of the blades 5 will be acted upon directly by the fluid and rotation of the turbine blades 5 and shaft 3 will cease.

As illustrated in Figure 5 and Figure 6, the orientation of all of the blades 5 can be altered from a power generating configuration to a non-generating configuration, where all blades 5 are shielded from the fluid flow. The blades 5 may be held in the non-generating configuration by a suitable arrangement such as a strap or band (not illustrated).

The control of altering the orientation of the blades 5 and the vane 13 between a generating and non generating configuration may be done remotely, for example from above the surface of the water. Hydraulic control lines located above the water level is one example of how the orientation of the blades 5 and the vane 13 can be controlled remotely.

The area of the blades 5 and the speed of rotation of the turbine shaft 3 will be a function of the situation in which the turbine assembly 1 is deployed and the amount of energy in the fluid flow at that location. The power output of each turbine 1 will be related to the size and speed of rotation.

Smaller units may be deployed for localised generation of electricity. For example, a smaller unit may be deployed from a stationary boat in harbour where tidal flow passes that boat. An example of a location for deployment of a turbine apparatus according to an embodiment of the invention is in a harbour mouth to harvest energy as tides ebb and flow.

While the invention has been shown and described with reference to certain exemplary embodiments, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention as defined by the appended claims and their equivalents.

CLAIMS

1. A turbine apparatus for locating in a fluid in which fluid flows in at least one direction, wherein the turbine apparatus comprises;-

a turbine shaft;

a plurality of movable blades circumferentially distributed relative to the turbine shaft, wherein each blade is movable from an active configuration in which the blade is oriented to provide a high resistance to fluid flow to a passive configuration in which the blade is oriented to provide a low resistance to fluid flow; and

a blade controlling means adapted to control orientation of the blades between the active configuration and the passive configuration.

2. A turbine apparatus according to claim 1, wherein the blade controlling means is separate from and movable relative to the blades.

3. A turbine apparatus according to claim 1 or 2, wherein the blade controlling means is positioned relative to the blades such that operation of the blade controlling means is such that the orientation of one or more blades changes from a passive to an active configuration.

4. A turbine apparatus according to claim 1, 2 or 3, wherein the blade controlling means is adapted to act upon the blades continuously to operate the turbine shaft.

5. A turbine apparatus according to any preceding claim, wherein the blade controlling means is configured such that it is positioned around one or more blades, wherein one or more blades is movable from a passive configuration to an active configuration substantially continuously to operate the turbine shaft.

6. A turbine apparatus according to any preceding claim, further comprising a guide member adapted to act upon one or more blades in a direction opposing fluid flow such that the blades are altered from an active configuration to a passive configuration.

7. A turbine apparatus according to claim 6, wherein the guide member is integral with the blade controlling means.

8. A turbine apparatus according to claim 6, wherein the guide member is coupled to the blade controlling means,

9. A turbine apparatus according to claim 6, 7 or 8, wherein the guide member is adapted to contact with one or more blades to alter the configuration of the blades from an active configuration to a passive configuration.

10. A turbine apparatus according to any of claims 6 to 9, wherein the blade controlling means is a cowling arranged to surround one or more of the blades and wherein the guide member is integral with or coupled to the cowling.

11. A turbine apparatus according to claim 10, wherein the cowling is arranged to surround half of the blades.

12. A turbine apparatus according to claim 10 or 11, wherein at least a leading edge of the cowling defines an inside diameter of the cowling that is less than the outside diameter of the turbine apparatus as defined by the blades in an active configuration.

13. A turbine apparatus according to claim 11 or 12, wherein at least a part of the guide member defines an inside diameter of the cowling that is less than the outside diameter of the turbine apparatus as defined by the blades in an active configuration.

14. A turbine apparatus according to claim 13, wherein the guide member includes guide rails.

15. A turbine apparatus according to claim 13 or 14, wherein the guide member includes a profiled inner surface.

16. A turbine apparatus according to any of claims 10 to 15, wherein the cowling comprises a window portion, providing a flow path through the turbine apparatus.

17. A turbine apparatus according to any preceding claim, further comprising a vane arrangement adapted to be coupled to the blade controlling means and operable such that the orientation of the blade controlling means relative to the direction of fluid flow is adjustable.

18. A turbine apparatus according to claim 17, wherein the vane arrangement is adjustable and coupled to the blade controlling means.

19. A turbine apparatus according to claim 17 or 18, wherein the vane is hingedly attached to the blade controlling means.

20. A turbine apparatus according to any of claims 19 to 19, wherein the vane is adjustable relative to the blade controlling means such that the turbine apparatus is in a non-generating state.

21. A turbine apparatus according to any of claims 17 to 20, wherein the position of the vane is adapted to be adjusted remotely.

22. A turbine apparatus according to any of claims 17 to 21, wherein the vane operates through ninety degree rotation.

23. A turbine apparatus according to any preceding claim, wherein the movable blades are each pivotally arranged relative to the turbine shaft.

24. A turbine apparatus according to any preceding claim, further comprising a rotational drum comprising at least two end flanges located at the longitudinal ends of the drum.

25. A turbine apparatus according to claim 24, wherein at least one end of each blade is pivotally connected to the flanges.

26. A turbine apparatus according to claim 24 or 25, wherein each end of each blade is pivotally connected to one of the two flanges.

27. A turbine apparatus according to any of claims 24 to 26, wherein at least one flange comprises a stop associated with each blade, wherein a stop is arranged relative to each of the plurality of movable blades to limit the amount of pivotal rotation of each blade in one direction when the blades are in the active configuration.

28. A turbine apparatus according to claim 27, wherein the drum acts as a stop in the opposite direction to the stop on the flange such that pivotal rotation of the blades is limited in the direction that corresponds with the blades in the passive configuration.

29. A turbine apparatus according claim 27 or 28, wherein the stops on the flange each include shock absorption such that the pivotal movement of the blades is controlled.

30. A turbine apparatus according to any preceding claim, further comprising a bearing arrangement between the turbine shaft and the blade controlling means such that rotation of the blade controlling means relative to the turbine shaft is substantially unimpeded.

31. A turbine apparatus according to any preceding claim, wherein the turbine apparatus is configurable between a power generating status and a non generating status.

32. A turbine apparatus according to claim 31, wherein all of the movable blades are adjustable to take up the passive configuration in a non-generating status.

33. A turbine apparatus according to any preceding claim, wherein the orientation of the blade controlling means is adjustable remotely.

34. A turbine apparatus according to any preceding claim, wherein the turbine shaft is substantially vertical.

35. A turbine apparatus according to claim 34, wherein the turbine apparatus is suspended from above the surface of the water in which there is fluid flow.

36. A turbine apparatus according to claim 34 or 35, wherein the turbine apparatus is anchored from below.

37. A turbine apparatus according to any preceding claim, wherein the turbine apparatus is fully immersed in fluid.

38. A turbine apparatus according to claim 37, wherein part of the turbine shaft is immersed in fluid.

39. A turbine apparatus according to any preceding claim further comprising a generating device connectable to the turbine shaft.

40. An electrical generating network comprising one or more turbine apparatuses according to any preceding claim.

41. A turbine apparatus as hereinbefore described and/or as shown in Figures 1 to 6.

42. An electrical generating network as hereinbefore described and/or as shown in Figure 4.

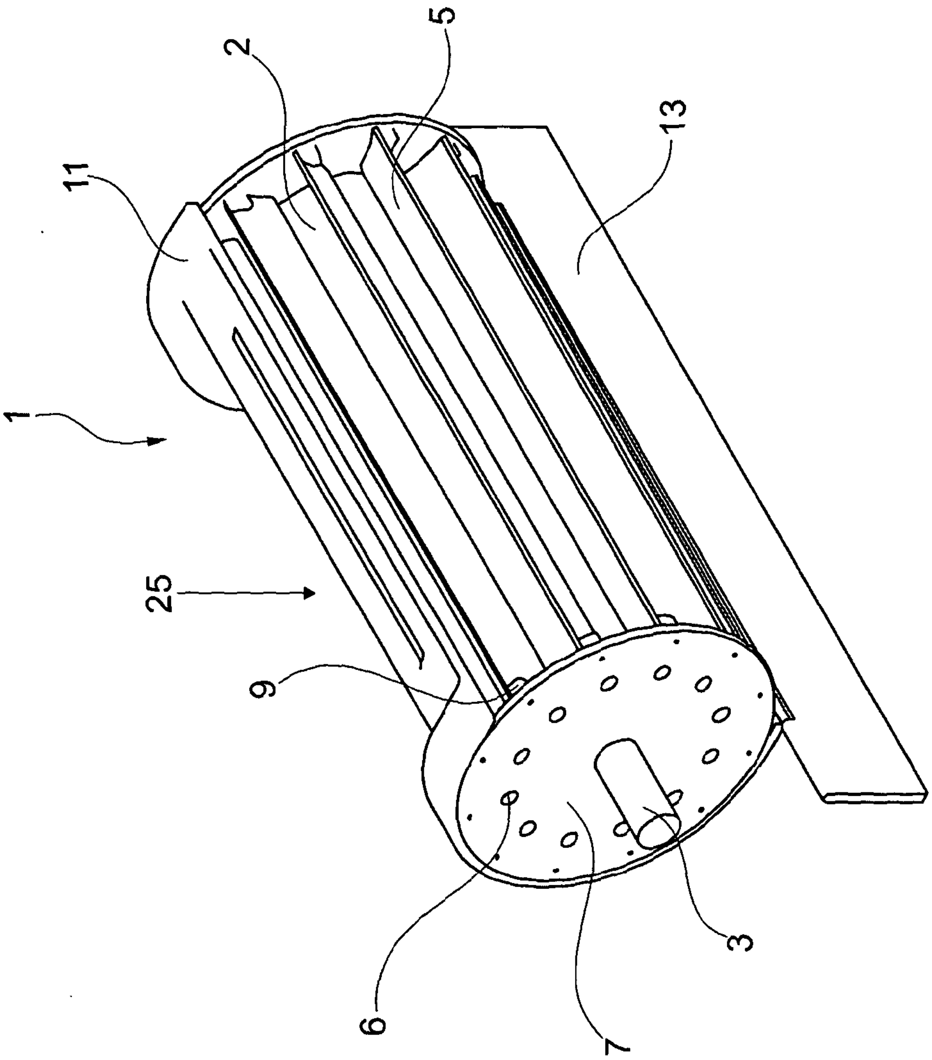


Fig. 1

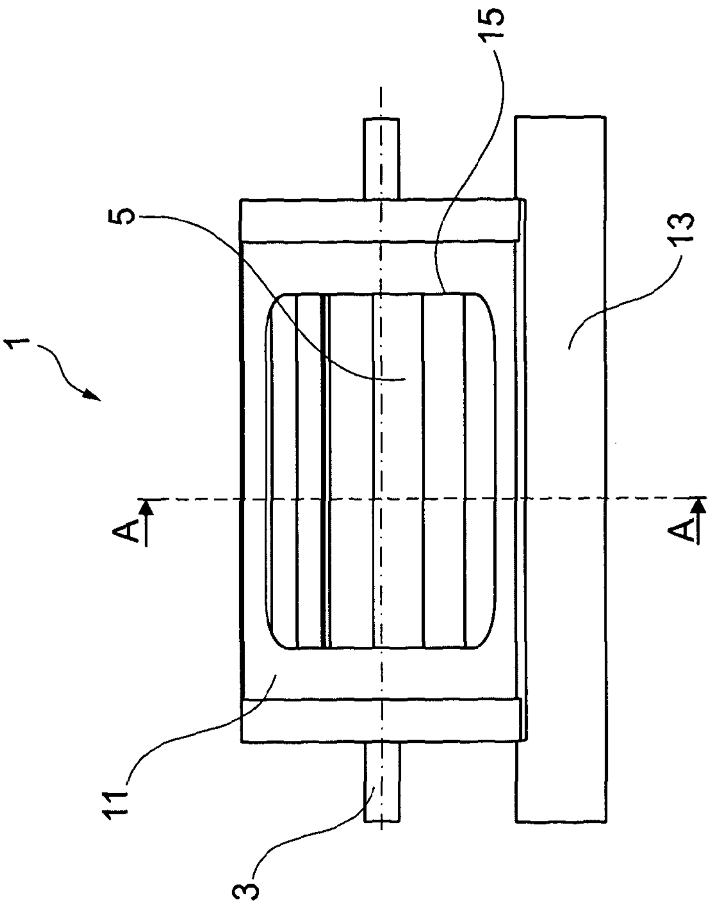
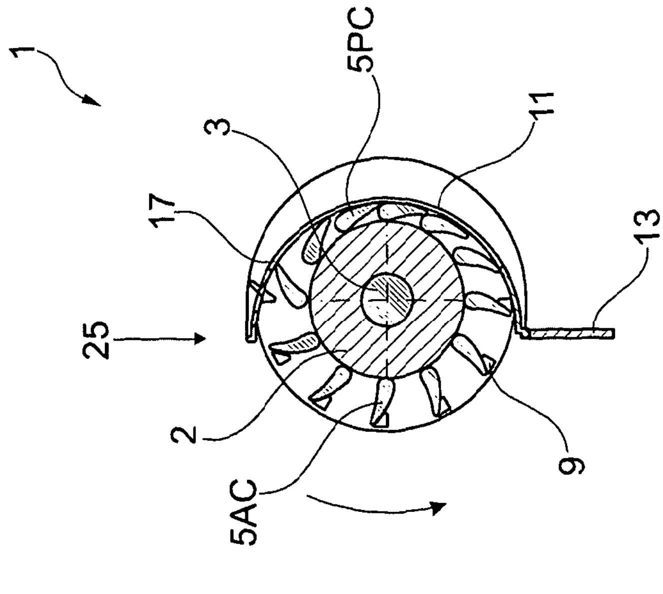


Fig. 3



SECTION A-A

Fig. 2

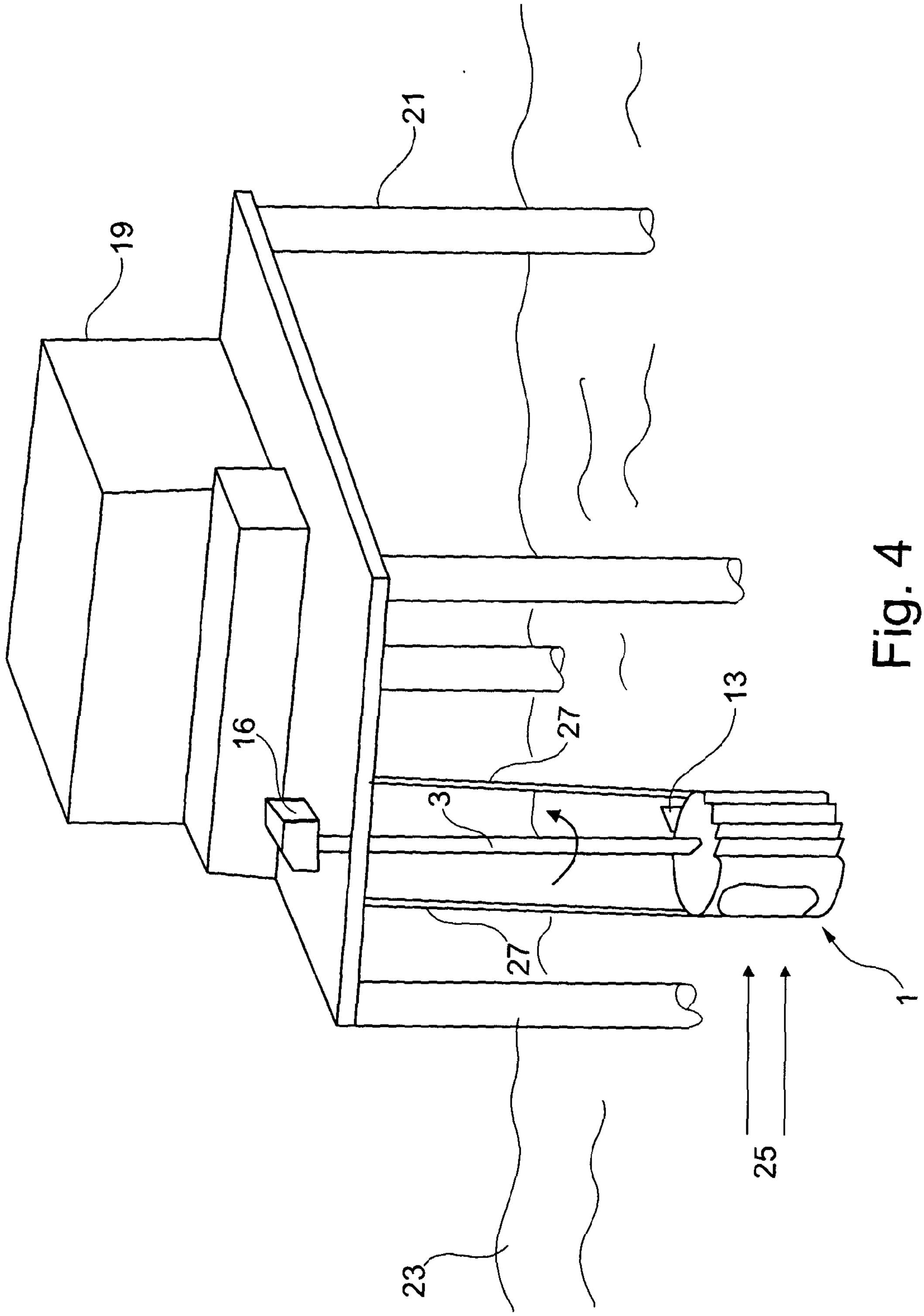


Fig. 4

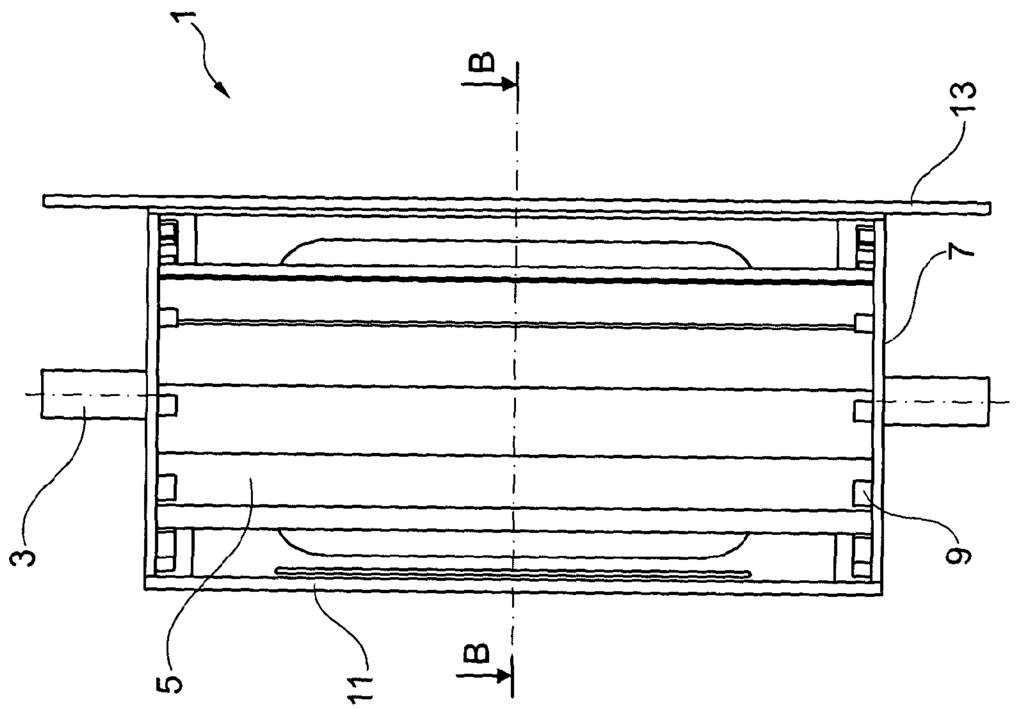
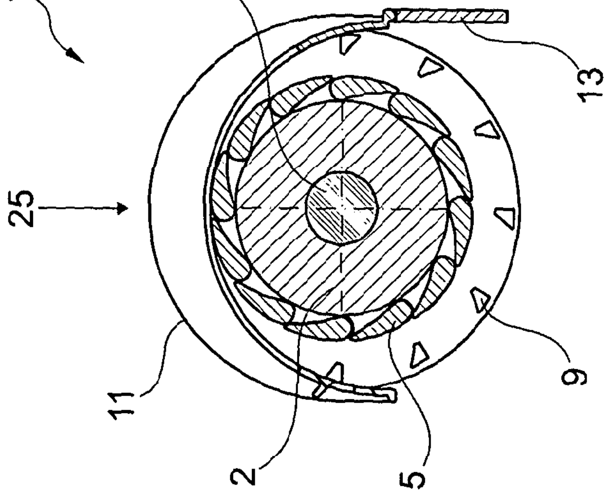


Fig. 6



SECTION B-B

Fig. 5