

**TURBINE ASSEMBLY,
AND KIT WITH COMPONENTS FOR ASSEMBLING THE SAME**

Field of the invention:

5 The present invention relates to a turbine assembly. More particularly, the present invention relates to a turbine assembly for generating electricity from the kinetic energy of a moving fluid flow, and also relates to a kit with corresponding components for assembling the turbine assembly.

10 **Background of the invention:**

 Known in the art are various assemblies used for generating electrical energy from wind, such as windmills, for example.

15 Most of the assemblies used in the field today are composed of multiple wide-span open rotor blades exposed directly to the wind, which are in turn connected to a complex and heavy transmission system, which in turn drives a corresponding generator. With these conventional assemblies, the wind impacts the blades, creating
20 a pressure differential forcing the blades to rotate about a transmission shaft, which in turn rotates corresponding gears connected to the shaft. Through gear reduction, the kinetic energy of the gears' rotational velocity is converted into electrical energy by the generator. The ability of these conventional assemblies to generate electrical energy depends largely on the size of the rotor blades and the speeds at which they can
25 rotate, as well as on the wind conditions in the immediate surroundings of these conventional devices, given that a considerable minimal wind speed is generally required in order to overcome the inertia of these heavy wide-span open rotator blades before they can even start to rotate, etc.

Known to the Applicant are the following US patents and patent applications which describe various types of turbine assemblies and the like: 4,080,100; 4,219,303; 6,127,739; 7,086,824 B2; 2008/0170941 A1; 2010/0215502 A1; 2010/0296928 A1; 2010/0310361 A1; and 2011/0037268 A1.

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The following patent documents also describe other similar related systems: FR 2589201 A1; DE 19513321 A1; and KR 101043279.

Also known in the art are the substantial drawbacks associated with such
10 conventional electricity-generating assemblies, such as, for example: a) the need to limit the rotational speed of the rotor blades to preserve blade structural integrity; b) the need to have complex and heavy hydraulic braking systems required to control the speed of the rotor blades so as to namely prevent them from rotating too fast which could be very undesirable for obvious reasons; c) the hydraulic braking systems used
15 to lower the rotational speed of the rotor blades decrease the amount of electrical energy that can be generated and increase the complexity of the overall assembly; d) the ever-increasing size of rotor blades creates much visual and acoustic pollution and negatively affects the flight and migratory activities of certain species (i.e. bats, birds, insects, etc.); e) the structural inertia of the long and heavy rotor blades results in
20 blades rotating only at relatively high wind speeds, thus restricting the locations at which these conventional devices can be operated; f) conventional electricity-generating assemblies are very big in scale and thus are often installed in "wind parks" requiring vast areas of land which are necessarily located far from cities and other areas of high energy consumption, thus increasing installation costs and further
25 reducing both generation capacity and transmission efficiency; g) conventional electricity-generating assemblies require much maintenance due to the great number of components that constitute the assemblies and the various complexities related thereto; h) etc.

Hence, in light of the aforementioned, there is a need for an improved system which, by virtue of its design and components, would be able to overcome or at least minimize some of the aforementioned prior art problems.

5 **Summary of the invention:**

The object of the present invention is to provide a system, which by virtue of its design and components, satisfies some of the above-mentioned needs and is thus an improvement over other related systems and/or methods known in the prior art, used
10 for generating electricity from a moving fluid flow (ex. wind, water, etc.).

In accordance with the present invention, the above object is achieved, as will be easily understood, with a turbine assembly, such as the one briefly described herein, and such as the one exemplified in the accompanying drawings.

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More particularly, and according to the present invention, there is provided a turbine assembly for generating electricity from kinetic energy of a moving fluid flow, the turbine assembly comprising:

an elongated casing defining a fluid channel through which the fluid flow is
20 allowed to travel;

an inlet having an effective cross-sectional area for receiving the fluid flow into the fluid channel, the inlet being further configured for directing the fluid flow into said fluid channel;

an outlet having an effective cross-sectional area for releasing the fluid flow out
25 from the fluid channel, the outlet being positioned downstream of the inlet along the fluid channel;

a main rotor contained within the casing and intersecting the fluid channel, between the inlet and the outlet, the main rotor being rotatably moveable with respect to the casing via a pivoting component, the main rotor having a closed-loop
30 arrangement provided with a plurality of rotor vanes each defining a neighbouring

closed-loop rotor passage, the closed-loop rotor passages of the main rotor providing an effective cross-sectional area through which the fluid flow is allowed to pass, the main rotor being rotatably driven via the passage of fluid flow through its closed-loop arrangement, and the closed-loop arrangement being further configured for imparting
5 a forced rotational movement to the fluid flow exiting from the main rotor; and

a main generator being operatively connectable to the main rotor and being driven by a rotation of said main rotor, in order to generate electricity, the main generator being contained within the casing and being positioned within said casing via a supporting component so as to be placed in a vortex region defined by the forced
10 rotational movement of the fluid flow exiting the main rotor.

Such a turbine assembly configuration is particularly advantageous in that it is capable of generating high levels of revolutions per minute (rpm) to the main rotor (and in turn, high levels of rpm to the main generator) even with very low speeds of fluid
15 flow entering the assembly. This is due namely to the casing which enables to advantageously guide and accelerate the fluid flow through a confined fluid channel, as well as to the particular closed-loop arrangement of the main rotor which further confines the fluid channel through a specific and optimal fluid path. The fact that the main rotor is preferably intended to be directly coupled to the main generator is also
20 advantageous according to the present invention because an increased rpm capability for the main rotor translates into an increased rpm capability for the main generator, and in turn, translates into an increased output of electricity for a same given fluid flow, when compared to what is possible by conventional systems with such a same given fluid flow. Moreover, given that according to the present invention, the closed-loop
25 arrangement of the main rotor is preferably further configured for imparting a forced rotational movement to the fluid flow as it exits from the main rotor, a vortex or "wake" region is created downstream of the main rotor, within the casing, where the generator is advantageously positioned therealong so as to also minimally interfere with the exiting fluid flow, given that forces and speeds of such rotational fluid flows are
30 greater/stronger away from the longitudinal axis of the fluid channel (i.e. radially

outward). Furthermore, in addition to having an increased rpm output when compared to conventional systems for the reasons mentioned earlier, the fact of having all of the components (ex. rotor, generator, etc.) of the present system contained within the same casing is also advantageous in that it enables for a high performing, yet very compact and much quieter turbine assembly, thereby overcoming several of the drawbacks associated with conventional turbine assemblies.

The turbine assembly according to a preferred aspect of the present invention can be arranged in an array of turbine assemblies, where the array of turbine assemblies is preferably raised in elevation with respect to a ground surface via a fixed vertical support structure.

According to yet another aspect of the present invention, there is also provided a kit with corresponding components for assembling and/or installing the above-mentioned turbine assembly.

According to yet another aspect of the present invention, there is also provided a set of components for interchanging with components of the above-mentioned kit.

According to yet another aspect of the present invention, there is also provided a method of assembling, installing and/or operating the above-mentioned turbine assembly.

According to yet another aspect of the present invention, there is also provided a method of assembling components of the above-mentioned kit and/or set.

According to yet another aspect of the present invention, there is also provided a network (ex. power grid) being provided with the above-mentioned turbine assembly.

According to yet another aspect of the present invention, there is also provided electricity generated with the above-mentioned turbine assembly and/or network.

The objects, advantages and other features of the present invention will become more apparent upon reading of the following non-restrictive description of preferred embodiments thereof, given for the purpose of exemplification only, with reference to the accompanying drawings.

Brief description of the drawings:

Figure 1 is a perspective view of a turbine assembly according to a preferred embodiment of the present invention.

Figure 2 is a side elevational view of what is shown in Figure 1.

Figure 3 is a cross-sectional view of the turbine assembly taken along line III-III of Figure 2.

Figure 4 is an enlarged view of a portion of what is shown in Figure 3.

Figure 5 is a front plan view of what is shown in Figure 2.

Figure 6 is a rear plan view of what is shown in Figure 2.

Figure 7 is another perspective view of what is shown in Figure 1, the turbine assembly being shown with its casing having been removed so as to better illustrate internal components of the turbine assembly.

Figure 8 is a side elevational view of what is shown in Figure 7.

Figure 9 is a cross-sectional view of the turbine assembly taken along line IX-IX of Figure 8.

Figure 10 is a front plan view of what is shown in Figure 8.

Figure 11 is a rear plan view of what is shown in Figure 8.

Figure 12 is a perspective view of the casing shown in Figure 1, the casing being shown cooperating schematically with a heating component according to a preferred embodiment of the present invention.

Figure 13 is a side elevational view of the casing shown in Figure 12.

Figure 14 is a front plan view of what is shown in Figure 13.

Figure 15 is a rear perspective view of the entrance cone shown in Figure 1.

Figure 16 is a rear plan view of what is shown in Figure 15.

Figure 17 is a cross-sectional view of the entrance cone taken along line XVII-XVII of Figure 16.

Figure 18 is a perspective view of a deflector according to a preferred embodiment of the present invention, the deflector being shown cooperating with a control device and/or heating component according to a preferred embodiment of the present invention.

Figure 19 is a front plan view of the deflector is shown in Figure 18.

Figure 20 is a cross-sectional view of the deflector taken along line XX-XX of Figure 19.

Figure 21 is a side elevational view of what is shown in Figure 19.

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Figure 22 is a perspective view of a deflector according to another preferred embodiment of the present invention.

Figure 23 is a front plan view of what is shown in Figure 22.

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Figure 24 is a cross-sectional view of the deflector taken along line XXIV-XXIV of Figure 23.

Figure 25 is a side elevational view of what is shown in Figure 23.

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Figure 26 is a perspective view of a deflector according to yet another preferred embodiment of the present invention.

Figure 27 is a front plan view of what is shown in Figure 26.

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Figure 28 is a cross-sectional view of the deflector taken along line XXVIII-XXVIII of Figure 27.

Figure 29 is a side elevational view of what is shown in Figure 28.

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Figure 30 is a rear perspective view of the first rotor (i.e. "complementary rotor") of the turbine assembly shown in Figure 1.

Figure 31 is a front perspective view of what is shown in Figure 30.

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Figure 32 is a rear plan view of what is shown in Figure 30.

Figure 33 is a side elevational view of what is shown in Figure 32.

5 Figure 34 is an enlarged view of a portion of what is shown in Figure 33.

Figure 35 is a top plan view of what is shown in Figure 32.

10 Figure 36 is a cross-sectional view of a portion of the rotor taken along line
XXXVI-XXXVI of Figure 35.

Figure 37 is a front perspective view of the second rotor (i.e. "main rotor") of the turbine assembly shown in Figure 1.

15 Figure 38 is a rear perspective view of what is shown in Figure 37.

Figure 39 is a rear plan view of what is shown in Figure 37.

20 Figure 40 is a side elevational view of what is shown in Figure 39.

Figure 41 is another side elevational view of what is shown in Figure 39.

Figure 42 is an enlarged view of a portion of what is shown in Figure 41.

25 Figure 43 is a top plan view of what is shown in Figure 39.

Figure 44 is a cross-sectional view of a portion of the rotor taken along line XLIV-XLIV of Figure 43.

Figure 45 is a front perspective view of a rotor according to yet another preferred embodiment of the present invention.

Figure 46 is a rear perspective view of what is shown in Figure 45.

Figure 47 is a rear plan view of what is shown in Figure 45.

Figure 48 is a side elevational view of what is shown in Figure 47.

Figure 49 is another side elevational view of what is shown in Figure 47.

Figure 50 is an enlarged view of a portion of what is shown in Figure 49.

Figure 51 is a top plan view of what is shown in Figure 47.

Figure 52 is a cross-sectional view of a portion of the rotor taken along line LII-LII of Figure 52.

Figure 53 is a perspective view of the rotatable shaft of the turbine assembly shown in Figure 1.

Figure 54 is a side elevational view of what is shown in Figure 53.

Figure 55 is a front perspective view of a first supporting component of the turbine assembly shown in Figure 1.

Figure 56 is a front plan view of what is shown in Figure 55.

Figure 57 is a top plan view of what is shown in Figure 56.

Figure 58 is a side elevational view of what is shown in Figure 56.

Figure 59 is a cross-sectional view of a portion of the supporting component taken along line LIX-LIX of Figure 58.

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Figure 60 is a rear perspective view of a second supporting component (i.e. "shaft support") of the turbine assembly shown in Figure 1.

Figure 61 is a front plan view of what is shown in Figure 60.

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Figure 62 is a top plan view of what is shown in Figure 61.

Figure 63 is a side elevational view of what is shown in Figure 61.

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Figure 64 is a cross-sectional view of a portion of the supporting component taken along line LXIV-LXIV of Figure 65.

Figure 65 is a perspective view of a third supporting component (i.e. "generator support") of the turbine assembly shown in Figure 1.

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Figure 66 is a front plan view of what is shown in Figure 65.

Figure 67 is a top plan view of what is shown in Figure 66.

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Figure 68 is a cross-sectional view of the supporting component taken along line LXVIII-LXVIII of Figure 66.

Figure 69 is a cross-sectional view of a portion of the supporting component taken along line LXIX-LXIX of Figure 66.

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Figure 70 is a perspective view of a coupling component of the turbine assembly shown in Figure 1.

Figure 71 is a side elevational view of what is shown in Figure 70.

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Figure 72 is a cross-sectional view of the coupling component taken along line LXXII-LXXII of Figure 71.

Figure 73 is a perspective view of a sleeve according to a preferred embodiment of the present invention.

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Figure 74 is a side elevational view of what is shown in Figure 73.

Figure 75 is a top plan view of what is shown in Figure 74.

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Figure 76 is a perspective view of a sleeve according to another preferred embodiment of the present invention.

Figure 77 is a side elevational view of what is shown in Figure 76.

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Figure 78 is a top plan view of what is shown in Figure 77.

Figure 79 is a perspective view of a spacer according to a preferred embodiment of the present invention.

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Figure 80 is a front plan view of what is shown in Figure 79.

Figure 81 is a side elevational view of what is shown in Figure 80.

Figure 82 is a perspective view of a screen according to a preferred embodiment of the present invention.

Figure 83 is a front plan view of what is shown in Figure 82, the screen being
5 shown provided schematically with an animal-detering mechanism according to a preferred embodiment of the present invention.

Figure 84 is a perspective view of a screen bracket according to a preferred
10 embodiment of the present invention.

Figure 85 is a top plan view of what is shown in Figure 84.

Figure 86 is a cross-sectional view of the screen bracket taken along line
LXXXVI- LXXXVI of Figure 85.
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Figure 87 is an enlarged view of a portion of what is shown in Figure 86.

Figure 88 is a perspective view of a turbine assembly according to another
20 preferred embodiment of the present invention.

Figure 89 is a perspective view of a longitudinal cross-sectional cut-away of the
turbine assembly shown in Figure 88.

Figure 90 is a perspective view of the intake nozzle of the turbine assembly
25 shown in Figure 88.

Figure 91 is a perspective view of a bracket for an entrance cone of a turbine
assembly according to a preferred embodiment of the present invention.

Figure 92 is a perspective view of a rotor according to yet another preferred embodiment of the present invention.

Figure 93 is a perspective view of a rotor provided with through-holes according
5 to a preferred embodiment of the present invention.

Figure 94 is a perspective view of a rotor sleeve according to a preferred embodiment of the present invention.

10 Figure 95 is a perspective view of a rotatable shaft according to another preferred embodiment of the present invention.

Figure 96 is a perspective view of a supporting component according to another preferred embodiment of the present invention.

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Figure 97 is an exploded perspective view of a pivot of the turbine assembly shown in Figure 88, according to a preferred embodiment of the present invention.

Figure 98 is a perspective view of a turbine assembly provided with an
20 externally mounted tubing for channeling a fluid flow according to a preferred embodiment of the present invention.

Figure 99 a perspective view of a longitudinal cross-sectional cut-away of what is shown in Figure 98.

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Figure 100 is a perspective view of a fan for use with the externally mounted tubing of Figure 98, according to a preferred embodiment of the present invention.

Figure 101 is a perspective view of a conceptual installation of an array of
30 turbine assemblies according to a preferred embodiment of the present invention.

Figure 102 is a perspective view of a turbine assembly provided with a system of shutters being shown in a closed configuration according to a preferred embodiment of the present invention.

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Figure 103 is another perspective view of what is shown in Figure 102, the system of shutters being now shown in an intermediate open configuration.

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Figure 104 is a perspective view of first and second coaxially mounted rotatable shafts to be used with a turbine assembly according to a preferred embodiment of the present invention.

Figure 105 is a side elevational view of what is shown in Figure 104.

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Figure 106 is a cross-sectional view taken along line CVI-CVI of what is shown in Figure 105.

Detailed description of preferred embodiments of the invention:

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In the following description, the same numerical references refer to similar elements. The embodiments, geometrical configurations, materials mentioned and/or dimensions shown in the figures or described in the present description are preferred embodiments only, given for exemplification purposes only.

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Moreover, although the present invention was primarily designed for generating electrical energy (i.e. "electricity") from the kinetic energy or force of a moving fluid flow, via at least one generator, it may be used for other types of purposes and with other types of objects, and in other fields, as apparent to a person skilled in the art. For this reason, expressions such as "electrical", "electricity", "generator", etc., used herein

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should not be taken as to limit the scope of the present invention and includes all other

kinds of objects or fields with which the present invention could be used and may be useful. Indeed, it may be appreciated that the present system could, for example, be used for generating mechanical energy (ex. torque, etc.) from the kinetic energy or force of a moving fluid flow, with or without a corresponding transmission system (ex. planetary gear transmission system), etc.

Moreover, in the context of the present invention, the expressions "station", "kit", "device", "assembly", "system" and "unit", as well as any other equivalent expressions and/or compounds word thereof known in the art will be used interchangeably, as apparent to a person skilled in the art. This applies also for any other mutually equivalent expressions, such as, for example: a) "fluid", "wind", "gas", "air", "exhaust", "water", "liquid", "flow", etc.; b) "guide", "direct", "channel", "conduct", "confine", "constrict", "funnel", "accelerate", etc.; c) "turn", "pivot", "rotate", "roll", etc.; d) "energy", "force", "movement", "flow", etc.; e) "speed", "velocity", "rotation", etc.; f) "arrangement", "array", etc.; as well as for any other mutually equivalent or related expressions, pertaining to the aforementioned expressions and/or to any other structural and/or functional aspects of the present invention, as also apparent to a person skilled in the art.

Furthermore, in the context of the present description, it will be considered that expressions such as "connected" and "connectable", or "mounted" and "mountable", may be interchangeable, in that the present invention also relates to a kit with corresponding components for assembling a resulting fully-assembled and fully-operational turbine assembly.

In addition, although the preferred embodiment of the present invention as illustrated in the accompanying drawings may comprise various components, and although the preferred embodiment of the turbine assembly as shown consists of certain geometrical configurations as explained and illustrated herein, not all of these components and geometries are essential to the invention and thus should not be

taken in their restrictive sense, i.e. should not be taken as to limit the scope of the present invention. It is to be understood, as also apparent to a person skilled in the art, that other suitable components and cooperation thereinbetween, as well as other suitable geometrical configurations may be used for the turbine assembly and corresponding components according to the present invention, as will be briefly explained hereinafter and as can be easily inferred herefrom by a person skilled in the art, without departing from the scope of the invention.

List of numerical references for some of the corresponding preferred components illustrated in the accompanying drawings:

- 1. turbine assembly (or simply "assembly")
- 3. fluid flow
- 3a. low-velocity (or "inner") fluid flow
- 3b. high-velocity (or "outer") fluid flow
- 5. casing
- 7. fluid channel
- 9. inlet
- 11. outlet
- 13. main rotor
- 13b. complementary rotor
- 15. pivoting component
- 17. closed-loop arrangement
- 19. rotor vane
- 19a. inner rotor vane
- 19b. outer rotor vane
- 21. rotor passage
- 21a. inner rotor passage
- 21b. outer rotor passage
- 23. main generator

- 23b. electromagnetic generator
- 23c. starter motor
- 25. supporting component
- 25a. first supporting component
- 5 25b. second supporting component (ex. "shaft support")
- 25c. third supporting component (ex. "generator support")
- 27. vortex region
- 29. inner ring (of main rotor 13)
- 31. outer ring (of main rotor 13)
- 10 33. median wall (of main rotor 13)
- 35. outer wall (of main rotor 13)
- 37. control device
- 39. heating component
- 41. hub (of rotor 13)
- 15 43. through-holes (of hub 41)
- 45. rotatable shaft
- 45a. first distal section (of rotatable shaft 45)
- 45b. second distal section (of rotatable shaft 45)
- 45c. middle section (of rotatable shaft 45)
- 20 47. shutter
- 49. deflector
- 51. deflector vane
- 53. orifice (of deflector 49)
- 55. leading edge (of deflector vane 51)
- 25 57. departing edge (of deflector vane 51)
- 59. longitudinal axis (of fluid channel 7)
- 61. input shaft (of generator 23)
- 63. coupling component
- 65. flexible component (of coupling component 63)
- 30 67. central housing (for generator 23)

- 69. support arm (of supporting component 25)
- 71. sleeve
- 73. intake nozzle
- 75. screen
- 5 75a. first screen (or "inlet" screen)
- 75b. second screen (or "outlet" screen)
- 77. aperture (of screen 75)
- 79. animal-detering mechanism
- 81. entrance cone
- 10 83. spacer
- 85. sensor
- 87. shaft housing
- 89. bearing
- 91. axis of rotation
- 15 93. pivot (of casing 5)
- 95. fixed support structure
- 97. array (of turbine assemblies 1)
- 99. auto-positioning mechanism
- 101. funnel tube
- 20 103. screen bracket
- 105. sleeve (of rotor 13)
- 107. fan (of funnel tube 101)
- 109. bracket (of entrance cone 81)

25 Broadly described, the present invention, as exemplified in the accompanying drawings, relates to a turbine assembly (1) for generating electricity from the kinetic energy or force of a moving fluid flow (3). Because the present invention may be used with a great variety of different applications, it can be easily understood by a person skilled in the art that the fluid flow (3) referred to in the context of the present invention

30 may come from a variety of different sources. For example, the fluid flow (3) may

originate from wind, gas, air, an exhaust, water, another type of fluid, and/or any other suitable type of "fluid flow" (3), as can be easily understood by a person skilled in the art.

5 Referring to Figures 1-11, the turbine assembly (1) comprises at least an elongated casing (5), an inlet (9), an outlet (11), a main rotor (13), and a main generator (23).

10 As can be easily understood by a person skilled in the art when referring to Figures 9-14, the casing (5) defines a fluid channel (7) through which the fluid flow (3) is allowed to travel. The fluid channel (7) is preferably the area defined within the casing (5). According to a preferred embodiment of the present invention, the casing (5) is preferably cylindrical, and preferably has a length and a radius which are multiples of about 6 inches. This advantageously simplifies the design and
15 manufacture of the overall turbine assembly (1) and its components, and further allows for scaling up assemblies (1) of greater size. However, it is worth mentioning that the casing (5) may take on various other shapes, forms and configurations, depending on the particular applications for which the turbine assembly (1) is intended for, and the desired end results. Indeed, it is worth mentioning that the casing (5) is not limited
20 necessarily to a cylindrical configuration, and that various portions thereof, may have other suitable geometrical configurations, whether square, rectangular, and the like, as can be easily understood by a person skilled in the art.

25 The turbine assembly (1) also comprises an inlet (9) having an effective cross-sectional area for receiving the fluid flow (3) into the fluid channel (7). The inlet (9) is further configured for directing the fluid flow (3) into the fluid channel (7). An outlet (11) also having a respective effective cross-sectional area for releasing the fluid flow (3) out from the fluid channel (7) is positioned downstream of the inlet (9) along the fluid channel (7). The inlet (9) and the outlet (11) are preferably circular, in order to be
30 complementary in shape to the preferred embodiment of the casing (5), but as

aforementioned, the inlet (9) and outlet (11) of the present turbine assembly (1) may take on various other suitable shapes, forms and configurations, once again depending on the particular applications for which the turbine assembly (1) is intended for and the desired end results, as can also be understood by a person skilled in the art.

In view of the above, and as can also be easily understood, according to a particular embodiment of the present invention, the effective cross-sectional area of the inlet (9) may be substantially greater than the effective cross-sectional area of the main rotor (13). This advantageously can increase the speed of the fluid flow (3) passing through the main rotor (13) with respect to the speed of the fluid flow (3) entering the inlet (9) by creating a "funnelling" effect. An increased speed of the fluid flow (3) passing through the main rotor (13) would in turn generate an increased output of electricity from the main generator (23) given that, according to a preferred embodiment of the present invention, the main generator (23) is intended to be directly coupled and driven by the main rotor (13).

As better shown in Figures 88-90, an intake nozzle (73) can also be removably mountable onto the inlet (9). This can further increase the speed of the fluid flow (3) entering the inlet (9). It is understood that a casing (5) with a larger cross-sectional area of the inlet (9) can be used in conjunction with the intake nozzle (73) to more effectively and further advantageously increase the speed of the fluid flow (3) entering the inlet (9), as apparent to a person skilled in the art.

In a preferred embodiment, and as shown in Figure 12, the casing (5) is provided with a heating component (39) which heats the fluid flow (3) entering and/or passing through the casing (5), thereby increasing the fluidity and kinetic energy of the fluid flow (3). This can allow for more energy to be extracted from the fluid flow (3) by the main rotor (13), thereby increasing the electricity produced by the assembly (1). As can be easily understood, the heating component (39) may be electrically supplied by

a portion of the electricity produced by the main generator (23) of the turbine assembly (1), so as to have a substantially "self-sufficient" assembly. The casing (5) is also preferably resistant to corrosion and allows paint to be applied thereto. These advantages can be achieved by treating the surface of the casing (5) with a material and/or through the materials used to construct the casing (5). In this regard, the casing (5) is preferably made from grade 316 stainless steel.

As better shown in Figures 1-11, 30-52 and Figure 92, the turbine assembly (1) comprises a main rotor (13). The main rotor (13) is contained within the casing (5) and intersects the fluid channel (7) which preferably runs between the inlet (9) and the outlet (11). The main rotor (13) rotates within the casing (5) via a pivoting component (15). In the preferred embodiments illustrated in the accompanying drawings, the pivoting component (15) preferably comprises a rotatable shaft (25) onto which the main rotor (13) is removably secured in a fixed manner, so that the main rotor (13) rotates with the rotatable shaft (45) within the casing (5). It is worth mentioning however that various other suitable pivoting components (15) may be used for ensuring that the main rotor (13) rotates within the casing (5) as a result of the fluid flow (3) passing therethrough, depending once again on the particular applications for which the turbine assembly (1) is intended for, and the desired end results, as apparent to a person skilled in the art. As way of a mere example, the main rotor (13) could ultimately be pivotably mounted about a central hub extending from a streamlined supporting component (25) being removably mounted onto the casing (5). In the preferred embodiments illustrated in the accompanying drawings, the rotor (13) is preferably mounted to the shaft (45) via a corresponding rotor bracket, such as the one exemplified in Figure 94. The main rotor (13) preferably has a "closed-loop arrangement" (17), and this closed-loop arrangement (17) allows the rotor (13) to be provided with at least one row or group of rotor vanes (19), as shown in Figure 32, for example. Each rotor vane (19) defines a neighbouring closed-loop rotor passage (21). These rotor passages (21) provide an effective cross-sectional area through which the fluid flow (3) is allowed to pass. As can be easily understood by a person skilled in the

art, the passage of fluid flow (3) through the closed-loop arrangement (17) drives the rotation of the rotor (13) about its pivoting component (15). Furthermore, the main rotor and the corresponding rotor vanes (19) and rotor passages (21) thereof are configured so that the passage of fluid flow (3) through the closed-loop arrangement (17) imparts
5 a forced rotational movement to the fluid flow (3) exiting from the main rotor (13) downstream. As can be also easily understood by a person skilled in the art, the exiting of the fluid flow (3) from the rotor (13) produces a neutral "zone" or "wake" in an area around the shaft (45) where the fluid flow (3) is relatively calm and/or turbulent free, and where the main generator (23) is advantageously placed according to the
10 present invention, within the casing, as will be explained in greater detail hereinbelow. Obviously, a person skilled in the art could easily understand that the main generator (23) could be positioned appropriately elsewhere within or outside the casing (5) without affecting the overall principle of the present turbine assembly (1).

15 As better shown in Figures 30-51, for a given rotor (13), the closed-loop arrangement (17) preferably comprises concentric inner and outer rings (29,31). The inner ring (29) can have a plurality of inner rotor vanes (19a) which each define a neighbouring closed-loop inner rotor passage (21a). The closed-loop inner rotor passages (21a) of the main rotor (13) can each provide a first effective cross-sectional
20 area through which an inner portion of the fluid flow (3) is allowed to pass. Similarly, the outer ring (31) is preferably provided with a plurality of outer rotor vanes (19b) each defining a neighbouring closed-loop outer rotor passage (21b), where the closed-loop outer rotor passages (21b) provide a second effective cross-sectional area through which an outer portion of the fluid flow (3) is allowed to pass. The outer rotor
25 vanes (19b) of the main rotor are preferably better adapted and configured for cooperating with a high velocity fluid flow (3b), whereas the rotor vanes (19a) of said main rotor (13) are preferably better adapted and configured for cooperating with a low velocity fluid flow (3a), as can be easily understood by a person skilled in the art. The inner ring (29) is preferably delimited from the outer ring (31) via a circumferential
30 median wall (33), as better shown in Figure 32, for example.

The closed-loop arrangement (17) is preferably also similar in shape and/or concentric with the rotor (13), and thus can be circular. It may therefore have an outer radius (r_1). The circumferential median wall (33) is also preferably circular and has a radius (r_2), which can be about 2/3 of the outer radius (r_1). The outer radius (r_1) can define a peripheral outer wall (35), which delimits the outer ring (31). This peripheral outer wall (35), in addition to improving the performance of the main rotor (13) rotating within the casing (5) for a given fluid flow (3), can also serve as a reinforcement component for maintaining the structural integrity of the main rotor (13) in that, as can be understood from the embodiments illustrated in the accompanying drawings, it also supports the outer edges and/or ends of the plurality of outer rotor vanes (19b).

As shown in Figures 39-52, the outer rotor vanes (19b) and the inner rotor vanes (19a) of the rotor (13) are preferably differently angled and/or curved. This can advantageously optimise the rotation of the rotor (13), which will likely operate in an environment where the velocity of the fluid flow (3) varies from the radius (r_2) to the outer radius (r_1) of the rotor (13). As but one example, and as aforementioned, the outer rotor vanes (19b) of the main rotor (13) can be configured for cooperating with a high-velocity fluid flow (3b), and the inner rotor vanes (19a) of said main rotor (13) are configured for cooperating with a low-velocity fluid flow (3a). Another example of such a differently curved profile occurs where the outer rotor vanes (19b) are radially offset with respect to inner rotor vanes (19a). Alternatively, the outer rotor vanes (19b) of the main rotor (13) can be radially aligned with respect to inner rotor vanes (19a) of said main rotor (13). Preferably, the main rotor (13) comprises about ten inner rotor vanes (19a) and about twenty outer rotor vanes (19b). According to a preferred possibility of the present system, at least one rotor vane (19) of the turbine assembly (1) may be preferably moveable with respect to its corresponding rotor (13) so as to have a variable pitch, and said variable pitch can be adjustably controlled by a control device (37) either within and/or outside the casing (5). Similarly to what was discussed earlier, the control device (37) could be electrically supplied by a portion of the electricity

generated by the main generator, so as to provide for a self-sufficient overall turbine assembly.

In another preferred embodiment, the turbine assembly (1) can be provided with a second, complementary rotor (13b), as better shown in Figures 1-11. The main rotor (13) and the complementary rotor (13b) can be placed side by side within the casing (5) so as to form an elongated overall rotor (13) within said casing (5). This advantageously can create a "cupping effect" where the rotor vanes (19) of the complementary rotor (13b) can be positioned, shaped and sized with respect to rotor vanes (19) of the main rotor (13) so as to form pairs of neighbouring vanes (19) (i.e. corresponding cupping "pockets") within the elongated rotor (13), thereby increasing rotation of the elongated rotor (13), as can be easily understood by a person skilled in the art. Preferably, the complementary rotor (13b) is placed upstream of the rotor (13).

According to other preferred embodiments, and similarly to the casing (5), the turbine assembly (1) can be provided with a heating component (39) which can heat the structure of the rotor (13) and/or the rotor vanes (19) so as to prevent an accumulation of ice on the overall structure and/or rotor vanes (19), as can be easily understood by a person skilled in the art. Indeed, such an accumulation of ice could result if the wind turbine assembly (1) is used in a cold environment and/or with a cold fluid flow (3), and may reduce the efficiency of the rotor (13), and as a result, may reduce the efficiency of the overall turbine assembly (1). Preferably also, and as better shown in Figure 93, the rotor (13) could also have a central hub (41) which is traversed by a series of through-holes (43), thereby reducing the weight of the rotor (13) and its corresponding structural inertia which allows the rotor (13) to rotate faster and at slower wind velocities. As understood by a person skilled in the art, the through-holes (43) are preferably sized, positioned and configured to not affect the rotational balance of the rotor (13). Preferably also, the rotor (13) is made from 7000 series Aluminum which offers the desired structural and corrosion-resistant properties.

Referring back to Figures 1-11, and as aforementioned, the turbine assembly (1) comprises a main generator (23). The generator (23) is operatively connectable to the main rotor (13) and is operatively driven by its rotation, thereby generating electricity. The generator (23) is also contained within the casing (5) and positioned within said casing (5) via a supporting component (25), such as a generator support (25c), so as to be placed in a vortex region (27) defined by the forced rotational movement of the fluid flow (3) exiting the rotor (13). As mentioned above, the vortex region is preferably a region of relatively calm and turbulence-fluid flow (3), which advantageously allows the generator (2) to be positioned in an area which does not interfere or alter the upstream fluid flow (3), thereby increasing the operative efficiency of the assembly (1). The positioning of the generator (13) is preferably coaxially about a longitudinal axis (59) of a segment of the fluid channel (7) so as to be cooled by rotating fluid flow (3) exiting the main rotor (13) and providing convectional cooling about the main generator (23).

As better shown in Figures 65-69, the generator support (25c) can be mounted within the casing (5), and can serve as a structural reinforcement component for the casing (5) for assisting in maintaining its overall structural integrity. The generator support (25c) also preferably comprises a central housing (67) which removably houses the main generator (23). The generator support (25c) can also include at least one streamlined support arm (69), which projects from the central housing (67) and which is operatively connectable to the casing (5). The generator (23) is preferably housed within the central housing (67) via a sleeve (71), as better shown in Figures 73-78, which is adjustable in size so as to receive therein differently sized generators (23). The sleeve (71) can advantageously also be configured to provide electromagnetic insulation. Preferably also, the generator support (25c) is made from grade 316 stainless steel. Once again, it is worth mentioning that the supporting component (25c) for the generator (23) may take on various other suitable embodiments, depending on the particular applications for which the turbine assembly (1) is intended for, and the desired end results, as apparent to a person skilled in the

art. For example, according to one particular embodiment, a bracket could be provided onto which the main generator (23) is removably and perpendicularly secured.

According to a preferred embodiment of the present invention, an input shaft
5 (61) of the generator (23) is operatively connectable to the main rotor (13), and more particularly, to the rotatable shaft (45) according to the embodiment illustrated in the accompanying drawings, which supports said main rotor (13), via a coupling component (63), as better shown in Figures 70-72, and as can be easily understood when referring to Figures 3 and 9, for example. This advantageously permits the
10 rotation of the input shaft (61) to be directly proportional to a corresponding rotation of the rotor (13), and the coupling component (63) is preferably configured so as to be easily connected or disconnected so as to allow for an easier inspection, maintenance and/or part replacement of components of the assembly (1). Preferably also, the coupling component (63) has a compensatory flexible component (65) for
15 compensating for variations in alignment which could take place between the rotatable shaft (45) and the input shaft (61).

Turning now to some of the preferred features and components of the assembly (1), and as better shown in Figures 18-29, the inlet (9) of the turbine assembly can
20 also be provided with a deflector (49). The deflector (49) is configured for directing the fluid flow (3) downstream of the inlet at an optimal attacking angle to the rotor vanes (19) of a given rotor (13,13b). The deflector (49) can include a plurality of deflector vanes (51) for achieving this functionality, and similarly to the vanes (19) of the rotors (13) of the assembly (1), the deflector vanes (51) of the deflector (49) each define a
25 neighbouring deflector passage through which the fluid flow (3) is allowed to pass. The deflector (49) is preferably fixedly mounted within the casing (5) such that it does not rotate and/or move in response to the fluid flow (3). It can also constitute a reinforcement component that structurally reinforces the casing (5), thereby assisting in maintaining an overall structural integrity of the casing (5) and reducing the need for
30 other structural supports, thus reducing the overall weight of the assembly (1). An

extremity of the rotatable shaft (45) is preferably pivotally mounted within the deflector (49), and as a result, according to a preferred embodiment of the present invention, the deflector (49) preferably includes a corresponding orifice (53) for receiving a first distal section (45a) of the shaft (45).

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The deflector (49) preferably has anywhere between about two and about eight deflector vanes (51), although other suitable number of deflector vanes (51) are possible with the present invention, depending on the fluid flow (3) being used, and other considerations, as apparent to a person skilled in the art. Each deflector vane (51), similar to the rotor vanes (19), can be moveable with respect to the deflector (49), so as to have a variable pitch, where the variable pitch is adjustably controllable by the control device (37). Each deflector vane (51) also preferably consists of a leading edge (55) facing toward the inlet (9) for directing the fluid flow (3). The leading edge (55) can have a leading angle with respect to the shaft (45). The deflector vane (51) also preferably has a departing edge (57) facing toward the outlet (11) at which the fluid flow (3) leaves the deflector vane (51). The departing edge (57) can have a departing angle with respect to the shaft (45). Each deflector vane (51) preferably spans between the leading edge (55) and the departing edge (57) so as to form an angled deflector vane (51). Once the fluid flow (3) leaves each deflector vane (51), it preferably impacts a corresponding rotor vane (19) at an angle normal to a surface of the rotor vane (19). The deflector (49) is preferably made from at least one material selected from the group consisting of 6000 series aluminum alloys and stainless steel, which meet the requirements for light-weight, corrosion resistance and/or structural rigidity, for example.

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According to another preferred embodiment, and as better shown in Figures 53-54, and in Figure 95, the pivoting component (15) according to a preferred embodiment of the present invention consists of a rotatable shaft (45), which is pivotally mountable onto at least one corresponding supporting component (25). The shaft (45) preferably extends substantially along a longitudinal axis (59) of the fluid

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channel (7). Each rotor (13,13b) can be fixedly mountable onto the rotatable shaft (45) so as to rotate therewith. The shaft (45) preferably has a first distal section (45a), as discussed above, which is pivotably mounted onto a first supporting component (25a), such as the deflector (49) at the inlet (9), for example. The shaft (45) can be pivotably mountable within the deflector (49) so as to rotate with respect to the deflector (49). Alternatively, the shaft (45) can be pivotably mounted to another supporting component (25a), which can be separated from the deflector (49) via a spacer (83), as exemplified in Figures 3 and 9.

As better shown in Figures 53 and 54, the rotatable shaft (45) preferably has different sections of different outer diameters. Each of the sections can be configured for cooperating with a corresponding component of the turbine assembly (1). For example, a first distal section (45a) can be configured for cooperating with a first supporting component (25a). A second distal section (45b) can be configured for cooperating with the main generator (23), and a middle section (45c) can be configured for cooperating with the main rotor (13). The middle section (45c) preferably has a diameter larger than that of the first distal section (45a), and the first distal section (45a) preferably has a diameter larger than that of the second distal section (45b). The second distal section (45b) can also be pivotably mounted onto a second supporting component (25b), which is fixedly mountable within the casing (5) downstream of the inlet (9). Examples of possible embodiments for a supporting component (25) are illustrated in Figures 55-64, and in Figure 96, and as can be easily understood when referring to Figures 1-11, the second supporting component (25b) is preferably positioned within the casing (5) between the main rotor (13) and the main generator (23), and can have a shaft housing (87) for removably housing a segment of a middle section (45c) of the rotatable shaft (45). It can also have at least one streamlined support arm (69) projecting from said shaft housing (87) and being operatively connectable onto the casing (5). Each support component (25) can also serve as a structural reinforcement component for the casing (5) for assisting in

maintaining its overall structural integrity. Preferably also, each supporting component (25) is made from grade 316 stainless steel.

As previously explained, the turbine assembly (1) and the components thereof
5 may take on various other suitable configurations depending on the particular applications for which the assembly is intended for, and the desired end results, and as an illustrative example, and according to one of the preferred embodiments of the present invention, as better illustrated in Figures 104 and 105, the shaft (45) can be made up of at least two coaxial shafts (45), in which case, the first coaxial shaft (45)
10 has a first rotor (13) rotatably mounted thereabout and is connected to a first generator (23), and the second coaxial shaft (45) is mounted concentrically within the first coaxial shaft (45), and has a second rotor (13) rotatably mounted thereabout and is connected to a second generator (23). Each coaxial shaft (45) has a rotational velocity substantially matching a rotational velocity of its corresponding rotor (13), thus
15 allowing the assembly (1) to produce electricity from two rotors (13), etc.

In order to facilitate maintenance, the alignment and integrity of the shaft (45) can be monitored by at least one sensor (85), which would monitor at least one parameter of each shaft (45) (i.e. alignment, vibration, rotational velocity, integrity,
20 etc.).

As shown in Figure 9, the rotatable shaft (45) is preferably removably mountable onto a corresponding supporting component (25) via a bearing (89), which allows the shaft to rotate with respect to the supporting component (25) while allowing
25 the supporting component (25) to remain stationary. The bearing (89) is preferably a stainless steel, lubricated ball bearing having ABEC 7 tolerances.

Returning now to the inlet (9) of the assembly (1), and as illustrated in Figures 1-11 and 82-83, the assembly (1) can have a first screen (75a) removably mountable
30 within the inlet (9) for preventing undesirable objects present in the fluid flow (3) from

entering into the fluid channel (7). The assembly (1) can also have a second screen (75b) removably mountable within the outlet (11) for preventing undesirable objects near the turbine assembly (1) from entering into the fluid channel (7) via the outlet (11). According to a preferred embodiment of the preset invention, each screen (75) is
5 removably mountable within the casing by means of at least one corresponding screen bracket (103), as exemplified in Figures 84-87, and preferably also, each screen (75) preferably defines a total circular cross-sectional area, and an effective cross-sectional area through which fluid flow (3) is allowed to pass, the effective cross-sectional area of each screen (75) being preferably between about 80% and about 85% of its total
10 cross-sectional area, as can be easily understood when referring to Figures 82 and 83.

The effective cross-sectional area of each screen (75) can be made of a plurality of apertures (77) having a shape selected from the group consisting of triangular, square, rectangular, polygonal, circular, etc. Once again, and as can easily
15 be understood by a person skilled in the art, various other suitable apertures or geometrical configurations could be used so as to provide a suitable screening for the fluid flow (3) entering the inlet (11) of the turbine assembly (1). Furthermore, as with the rotor (13) and the casing (5), each screen (75) can be provided with a heating component (39) for heating corresponding sections of each screen (75) so as to
20 prevent an accumulation of ice, and/or heating the fluid flow (3) entering the assembly (1) for improving the fluidity and the efficiency thereof. The screen (75) or any other suitable components of the turbine assembly (1) may also be equipped with an animal-detering mechanism (79) for deterring animals from approaching the turbine assembly (1), an example of which is schematically illustrated in Figure 83. This mechanism (79)
25 preferably comprises an electromagnetic field produced by a current running through a corresponding screen (75), or a sound-emitting mechanism (79). The sound-emitting mechanism (79) can be a high-frequency sound-emitting mechanism provided by the corresponding screen (75). Similarly to other components of the assembly (1), each screen (75) is preferably made from a corrosion-resistant material, such as grade 316
30 stainless steel, for example.

Upstream of the inlet screen (75), and as illustrated in Figures 1-11 and in Figures 15-17, the assembly (1) preferably has an entrance cone (81) which is removably mountable to a corresponding supporting component (25), such as a deflector (49), for example. The entrance cone (81) can be positioned upstream of the inlet (9) for streamlining fluid flow (3) entering into the inlet (9). The cone (81) is preferably mounted to supporting component (25) via bracket such as the one shown in Figure 91.

Preferably upstream of the entrance cone (81), and as better shown in Figures 102 and 103, the assembly (1) can be equipped with at least one adjustable shutter (47) in fluid communication with the inlet (9). The system of shutters (47) adjustably operates between opposite opened and closed configurations, and adjustably controls the fluid flow (3) entering the inlet (9), and thus also controls the rotational speed of each rotor (13) and the electricity output of the main generator (23), without the need for conventional hydraulic braking systems. In a preferred embodiment, the assembly (1) can also be provided with an electromagnetic generator (23b) which is operatively connected to a given rotor (13) and which generates an electromagnetic resistance which adjustably impedes the rotation of the rotor (13), and in turn adjustably controls the electricity output of the main generator (23). Preferably, the main generator (23) serves this function. Therefore, once again, the innovative design of the present turbine assembly (1) is such that it does not require additional braking systems as is the case with conventional windmills and/or the like.

In an alternative preferred embodiment, the turbine assembly (1) comprises a starter motor (23c) which is operatively connected to the rotor (13). The starter motor (23c) can provide an impulsive rotation to the rotor (13) when the fluid flow (3) is travelling through the fluid channel (7) is below a given threshold speed, such as about 4 m/s, for example. Preferably, the main generator (23) is further configured to serve this purpose. Therefore, it may be appreciated that the main generator (23) according

to the present invention may be configured to take on various different functions within the turbine assembly (1), each of these functions providing a corresponding considerable advantage to the overall assembly (1).

5 Once again, several modifications could be made to the present turbine assembly (1) without departing from the scope of the present invention. Indeed, the turbine assembly (1) and its corresponding components may take on various other suitable shapes, forms and configurations, depending on the particular applications for which the turbine assembly (1) is intended for, and the desired end result, as can be
10 understood by a person skilled in the art. As way of an example, and according to an alternative preferred embodiment, at least one rotor (13) may be concentrically and rotatably mountable about the main generator (23), and rotate about the main generator (23), so as to generate electricity. The assembly (1) preferably may comprise a plurality of rotor/generators configured in this way, and mounted in series.
15 Alternatively, at least one generator (23) can encase a corresponding rotor (13), such that rotation of the rotor (13) induces an electric current in the at least one generator (23) thereby producing electricity. Thus, it may now be better appreciated that the main rotor (13) and the main generator (23) need not be placed next to one another within the casing (5), and that they may be concentrically mounted with respect to one
20 another, while still being able to carry out their corresponding respective functions and resulting advantages, according to the present invention, and such an alternative embodiment would enable an even more "compact" overall turbine assembly (1).

 In yet another preferred embodiment, the assembly (1) comprises an auto-
25 positioning mechanism (99) which automatically and continually positions the inlet (9) to face a direction of greater fluid flow (3). As shown in Figure 88, 89 and 97, the auto-positioning mechanism (99) preferably comprises at least one axis of rotation (91), which is mountable onto at least one corresponding pivot (93) of the casing (5).

The assembly (1) according to the present invention, and as further described herein, can be grouped or mounted in a variety of places and to a variety of structures. As but one example of this, and as shown in Figure 101, the turbine assembly (1) is raised in elevation with respect to a ground surface via a fixed vertical support structure (95). The fixed vertical support structure (95) can be selected from the group consisting of a pole, rod, pylon, building and ventilation shaft, or any other suitable fixed support structure, for example. Alternatively, the turbine assembly (1) can be removably mountable onto a moving vehicle for generating electricity from a fluid flow (3) resulting from a displacement of the vehicle, whether that vehicle be a car, a transportation truck, a train, an airplane, or any other suitable type of vehicle where the presence of a turbine assembly (1) according to the present invention could be useful. In such a vehicle-mounted configuration, the assembly (1) can serve as an auxiliary supply of electric energy to a main supply of electric energy of the vehicle. In yet another alternative embodiment, whether fixed or moving, the turbine assembly (1) is part of an array (97) of identical turbine assemblies, where each turbine assembly (1) can be placed one above the other, and/or side by side with respect to one another.

According to another aspect of the present invention, there is provided a corresponding kit configured for assembling the components of the turbine assembly (1), such as the various components briefly described herein, and those exemplified in the accompanying drawings, so as to form an overall fully-assembled and fully-operational turbine assembly (1), the components including at least the casing (5), inlet (9), outlet (11), main rotor (13) and a main generator (23).

According to another preferred embodiment, and as shown in Figures 98-100, the assembly (1) can be provided with a funnel tube (101) for funnelling the fluid flow (3) into the casing (5), for testing purposes, for example. The funnel tube (101) can be equipped with a fan (107) for providing a fluid flow (3) into the funnel tube (101).

Having discussed some of the principal components and features of the turbine assembly (1) according to the present invention, some of the other preferential embodiments will be further discussed hereinbelow.

5 Indeed, as previously explained, the turbine assembly (1) according to the present invention, and as shown in the accompanying drawings, is a device which, in its preferred intended use, is an improved assembly (1) forming a resulting system, which may be provided with a complementary tool, such an support pole or rod to maintain the assembly (1) at an elevated position so as to benefit from increased and
10 more reliable wind speeds at higher altitudes.

As better illustrated in Figure 101, a vertical support structure (95), or "pole" in a preferred embodiment, can be provided with a plurality of assemblies (1). The assemblies (1) can be mounted side-by-side by any known technique in the art, up the
15 length of the pole (95) or along a portion thereof, depending on the surrounding environment and wind conditions. The pole (95) preferably has a base for supporting the pole (95). The pole (95) can also be provided with instruments and equipment for communicating with the plurality of assemblies (1) such as, but not limited to, telemetry equipment, wireless signaling, wiring to transmit electricity and/or signals, motors for
20 orientating the assemblies (1), etc. These instruments and/or equipment can be mounted in an instrument case, preferably near the base of the pole (95).

It is understood that the vertical support structure (95) is not limited to a free-standing pole, for example. Indeed, in another preferred embodiment of the present
25 invention, the assemblies (1) can be mounted to a structure such as a building, a sky scraper, an edifice, etc. In such a configuration, the assemblies (1) are preferably mounted to an exterior wall of the structure, preferably at a right-angled corner so as to benefit from intersecting air flows, as well as from air flows generated by rising hot air from surfaces below the assemblies (1). The assemblies (1) can also be mounted to

the exterior of every floor of the structure, every second floor, or any other variation of the same, as apparent to a person skilled in the art.

In yet another preferred embodiment, the vertical support structure (95) is a chimney, smoke stack and/or any other conduit that channels heated vapors. In this embodiment, the assemblies (1) are preferably mounted within the chimney and orientated so as to generate electrical power from the rise of heated air within the chimney. The assemblies (1) are preferably made of suitable materials known in the art capable of resisting high temperatures. Mounting the assemblies (1) within the chimney allows the assembly (1) to benefit from a more laminar air flow, which also has more potential energy due to its elevated temperature which is capable of being converted into electrical power.

Furthermore, and as previously mentioned, the turbine assembly (1) is not limited to generating electrical energy from only air and other low-density fluids, but includes generating electrical energy from higher-density fluids such as, but not limited to, water and/or seawater. In such a configuration, the assembly (1) is a hydraulic turbine for operating at and/or below water level, and generating an electrical energy in response to the passage of water through the hydraulic turbine. For exemplification purposes only, the hydraulic turbine may generate electric energy by extracting the potential and/or kinetic energy from moving water such as freshwater and/or sea water tides, river flows, currents, etc. Thus, it is now apparent how the assembly (1) and/or its components and features can be adapted to generate electrical energy from fluids of varying density by using suitable materials for the given fluid (i.e., a hydraulic turbine may require the use of more corrosion-resistant materials than a wind turbine, and may be permitted heavier components, etc.), as apparent to a person skilled in the art.

As shown in Figures 1-14, The casing (5) encloses the interior of the fluid channel (7) and is preferably designed and constructed so as to increase the speed of

the airflow from when it enters via the inlet (9) to when it exits via the outlet (11), as can be easily understood by a person skilled in the art. The casing (5) preferably has a diameter up to about 2', which can be larger for higher capacity assemblies (1), and can be up to around 5' in length, but is not limited to this length. Indeed, the casing (5) can extend upstream of the inlet (9) forming a duct, channel, conduit, etc. for receiving air before it reaches the inlet (9). This extension of the casing (5) is preferably a rectangular duct, which can reduce turbulences in the incoming airflow so as to optimize the performance of the assembly (1), as apparent to a person skilled in the art. The casing (5) can be a cylindrical conduit with mounting apertures which can be configured for receiving and securing the internal components of the assembly (1).

The inlet (9) is preferably profiled or smooth to reduce the air friction and turbulence of the incoming airflow. A preferred honeycomb and/or electric screen (75) is insertable into the inlet (9) and secured thereto with the mounts and positioned so as to optimally direct the airflow towards the rotor (13), as can be easily understood by a person skilled in the art. The preferred honeycomb screen (75) may be heated in order to optimise the aerodynamic characteristics of the airflow entering the enclosed inlet (9), or in order to prevent ice or snow from accumulating on the screen (75) and restricting the airflow. It is to be understood that the form of the apertures of the honeycomb screen (75) are not limited to honeycombs, and may comprise other shapes and/or configurations depending on the local environment in which the assembly (1) is placed, as apparent to a person skilled in the art, and as further illustrated in Figures 82 and 83. Preferably also, the enclosed inlet (9) may comprise shutters (47) or other like device(s) being positioned at the entrance, as illustrated in Figures 102 and 103. The shutter (47) or other like device(s) can be easily manipulated for eliminating or for controlling the airflow entering the enclosed inlet (9), thereby conveniently slowing down or stopping the assembly (1) without the use of brakes.

As shown in Figures 65-67, a generator support (25c) preferably is fixed at an end to the casing (5), and may also be fixed at another end to the central housing (67). The generator supports (25c) are sized and configured so as to suitably support the mass of the generator (23) and the central housing (67) and so as to not interfere or affect the upstream airflow. In a preferred embodiment, the generator support (25c) can be a planar plaque or face mount, where the generator (23) is axially bolted to the generator support (25c). In such a configuration, the generator shaft (61) goes through the generator (23) and connects to the rotatable shaft (45). This junction can be performed directly in the generator support (25c) and the generator (23) is thus supported by this flat element plaque. The central housing (67) is sized and configured to receive a suitable generator (23) and so as to not interfere or affect the upstream airflow, as can be easily understood by a person skilled in the art. The housing (67) can also accommodate a sleeve (71), as illustrated in Figures 73-78. The sleeve (71) preferably encases the generator (23) within the housing (67), and provides a level of electric, magnetic and/or electromagnetic insulation, thus neutralising the effect of the generator (23) on surrounding parts and/or areas. Preferably, the shaft (45) comprises an at least one pin, peg or other like suitable device for rotatably engaging the generator (23) and securing the connection between the two components such that the generator (23) and/or its shaft (61) rotate at the same rotational velocity as the shaft (45). The generator (23) can have a different number of sectors having windings with magnets to reduce friction and noise. For example, the generator (23) can have 12 or 16 sectors which reduce friction, instead of 3 or 4 sectors known in standard generators, which improves efficiency.

As illustrated in Figures 1-11, bearings (89) can be mounted about the shaft (45) so as to support the shaft (45) and/or other components and facilitate their rotation, as understood in the art. Preferably, the bearings (89) are mounted both to the front (i.e. upstream) and end (downstream) of the shaft (45), so as to provide rotatable support thereto. This configuration of the bearings (89) can have the effect of reducing drag in the assembly (1). Preferably also, all components of the assembly (1)

that are rotatable about the shaft (45) are mounted on bearings (89). In another preferred embodiment of the invention, the shaft (45) can comprise at least two co-axial shafts. One of the co-axial shafts (45) can be connected to a first corresponding rotor (13), and the other co-axial shaft (45) can be mounted to a second corresponding rotor (13). This configuration allows each co-axial shaft (45) to be connected to a separate generator (23) and to rotate at varying speeds which roughly correspond to the rotational speeds of the corresponding rotors (13).

10 In another preferred embodiment, and as illustrated in Figures 1-11, the shaft (45) can be mounted to at least one shaft support (25b). The shaft support (25b) can be configured to be fixedly secured to the casing (5), and may have an aperture through the center for supporting the shaft (45) so as to facilitate its rotation and reduce the friction associated thereto.

15 Referring now to Figures 1-11, and according to a preferred embodiment of the present invention, the airflow arriving at the inlet (9) impacts the deflector (49). The deflector (49), or any other suitable device known in the art, remains in a fixed position and directs the airflow towards the rotor vanes (19) of the rotor (13). The deflector (49) is mountable within the casing (5) and concentrically mountable about bearings (89), said bearings (89) themselves concentrically and rotatably mountable about the shaft
20 (45) in order to support the mass of the deflector (49) while maintaining it in a fixed position.

The deflector (49) need not be mounted about the shaft (45), and can also be
25 mounted in any other suitable fashion so as to maintain its fixed position, as can be easily understood by a person skilled in the art. For example, the deflector (49) can be fixedly secured to the casing (5) itself. Preferably, the deflector vanes (51) are sized, angled, and constructed of materials in order to optimally direct the airflow to the rotor vanes (19) of the rotor (13), as can be easily understood by a person skilled in the art.
30 In a preferred embodiment, and as exemplified in Figures 18-29, the number of

deflector vanes (51) can vary depending on the applicable airflow conditions. For example, the deflector (49) can have 8, 4, or even 2 vanes (51), as apparent to a person skilled in the art. Preferably, the deflector vanes (51) are rotatable and/or have a variable pitch. In such a configuration, the deflector vanes (51) can be mounted
5 about rotating bearings or any other suitable mechanical device that allows the rotation of the vanes (51). Furthermore, the assembly (1) can be provided with more than one deflector (49), depending on the turbulence of the incoming airflow and/or other factors such as air mass flow, airflow direction, etc., as apparent to a person skilled in the art, so as to stabilize or make laminar the incoming airflow before impacting the at least
10 one rotor (13), as explained below.

Preferably, after leaving the deflector vanes (51), the airflow impacts the rotor vanes (19) of the at least one rotor (13), which is mountable within the casing (5) and concentrically and rigidly mountable about the shaft (45) such that the angular velocity
15 of the shaft (45) is equal to the angular velocity of the rotor (13), as can be easily understood when referring to Figures 1-11. The term "vane" is used herein for exemplification purposes only but can be substituted for airfoils, blades, rotors or any other like device, as understood by a person skilled in the art. Preferably, and as exemplified in Figures 30-52, the rotor vanes (19) of the at least one rotor (13) are
20 sized, angled, and constructed of materials in order to maximize the extraction of kinetic energy from the airflow. In another preferred embodiment of the present invention, there is provided a plurality of rotors (13), each preferably angularly offset from the corresponding rotor (13) directly upstream. In another preferred embodiment, the generator (23) is mounted concentrically within the rotor (13).

25

Each of the rotors (13) in such a configuration can have differently-angled rotor vanes (19) so as to maximize the extraction of energy from the passing airflow. For example, the rotor (13) most upstream may have light angled rotor vanes (19) because the incoming air has the most potential energy, whereas rotor (13)
30 downstream of this first rotor (13) may have rotor vanes (19) with more steep angles

so as to maximize energy extraction from the more slow moving airflow. The angle and/or the pitch of the turbine rotor vanes (19) can also be varied and/or rotatable, as explained above with regard to the deflector vanes (51), with the goal of optimizing energy extraction.

5

In yet another preferred embodiment of the present invention, there is provided a rotor (13) comprising an electrical generator (23) being selectively and concentrically mountable within the interior of the rotor (13), said electrical generator (23) being rotatably and concentrically mountable about the shaft (45), such that a plurality of like
10 rotor (13) comprising electrical generators (23) can be mounted in series in order to maximize the extraction of kinetic energy from the airflow.

In another preferred embodiment of the invention, there is provided an alternating pattern of components when moving from upstream to downstream along
15 the assembly (1). For example, when the airflow enters the inlet (9), it may first encounter and be directed and/or diverted by the deflector (49). After which, the airflow encounters a high-energy rotor (13) which extracts the most energy from the airflow. The airflow then encounters at least one other rotor (13), which can extract the energy remaining in the airflow after the high-energy rotor (13). Any remaining airflow can
20 then exit via the air outlet (11).

According to a preferred embodiment of the present invention, there is provided an at least one guidance fin being secured and engaging an at least one mounting recess located at the rear of the casing (5). Preferably, the at least one guidance fin is
25 sized and constructed in order to produce sufficient moment force to automatically and continuously rotate the assembly (1) in response to the force imputed by the wind such that it can face into the wind at all times, as can be easily understood by a person skilled in the art.

As illustrated in Figures 70-72, the assembly (1) can also be provided with a coupling component (63) for coupling the shaft (45) to the generator (23). The coupling component (63) has an input for rotatably receiving an end of the shaft (45), and an output for transmitting the rotational energy of the shaft (45) to the generator (23).

5

Preferably, the assembly (1) is provided with a entrance cone (81) for directing the air flow into the inlet (9) and for making the airflow more laminar, as apparent to a person skilled in the art, and as illustrated in Figures 15-17. The cone (81) can also help to deviate airflow away from the "neural zone" described above and towards the deflector vanes (51).

10

In another preferred embodiment, the rotor (13) and/or other components of the assembly (1) can be housed within the generator (23). The generator (23) can house the assembly (1), which advantageously simplifies the design and operation of the assembly (1) and reduces its structural inertia. Preferably, an electrical charge is induced in the generator (23) by electrical inductance which can result from the rotation of the rotor (13) in conjunction with a brushes and/or brushless known electric motor, for example. Furthermore, the encase wind turbine (1) in this preferred configuration can be equipped with bearings (89) with attachments which maintain the components of the assembly (1) in rotatable relation with the shaft (45) and/or other components. These bearings (89) can be high-speed bearings (89), for example, and can also include a hydraulic gearbox for heavier assemblies (1). It is therefore apparent how in this preferred embodiment, the assembly (1) can become the generator (23) itself. In another preferred embodiment, magnets can be arranged circumferentially around a rotor (13) so that when the rotor (13) rotates, an electric charged is induced in the magnets.

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According to a preferred embodiment of the present invention, the assembly (1) is rotatably installed on a platform such that it can be automatically, electronically or manually positioned to face into the wind.

30

According to the present invention, the assembly (1) is preferably made of substantially rigid but lightweight materials, such as metallic materials (aluminum, zinc, stainless steel and/or others, as well as combinations thereof), hardened polymers, composite materials, and/or the like, whereas other components thereof according to the present invention, in order to achieve the resulting advantages briefly discussed herein (ex. easy rotation, lightweight, low cost, etc.), can be made of a polymeric material (plastic, rubber, etc.), and/or the like, depending on the particular applications for which the assembly (1) is intended for and the different parameters in cause (wind speeds, ambient environment, etc.), as apparent to a person skilled in the art.

Furthermore, the present invention is a substantial improvement over the prior art in that, by virtue of its design and components, the assembly (1) is simple and easy to operate, as well as is simple and easy to manufacture and/or assemble, without compromising the reliability of its functions. Hence, it may now be appreciated that the present invention represents important advantages over other wind turbines known in the prior art, in that the assembly (1) according to the present invention enables the generation of electrical power in a plurality of environments at relatively low wind speeds, due namely to its simple but innovative assembly components, as briefly explained hereinabove.

Indeed, contrary to the devices of the prior art, the present assembly (1) can be operated at wind speeds as low as about 0.5 m/s compared with wind speeds of at least about 5 m/s for conventional wind turbines because the enclosed inlet (9) augments the speed of the airflow for treatment by the rotor (13), as well as because of the starter motor which can provide an initial impulse rotation to the rotor (13). The ability to operate at such low wind speeds enables the assembly (1) to be used in many different locales where wind speeds are lower and/or highly variable. As but one example, and as discussed above, the assembly (1) can be of a small enough size to be installed onto a corner of a building, or in a chimney chute, so as to capture unused

wind and/or heat energy in these locations. Furthermore, the assembly (1) reduces the inherent friction that can afflict conventional devices because the shaft (45) is coupled relatively directly to the generator (23), and does not depend on gear reduction to generate electricity.

5

Moreover, the ability to operate at such low wind speeds enables the assembly (1) to be operated near areas of high energy consumption such as cities or major industrial installations, thus reducing the power losses associated with electrical power transmission over long distances as is common with the devices known in the art.

10 Furthermore, the relatively low wind speeds at which the present invention can operate permit the assembly (1) to be much smaller than conventional devices and still produce the same amount of electrical energy, thus providing a significant weight advantage, and further allow for a plurality of assemblies (1) to be installed on an apparatus within near proximity of each other, as illustrated in Figure 101. Such
15 advantages are further amplified by the ability of the rotor vanes (19) of the rotor (13) and/or the vanes (51) of the deflector (49) to be rotatable about themselves thus maximizing the rotational speed of the rotor (13) for given airflow conditions. The assembly (1) also advantageously operates at lower decibel levels, which can restrict the location of conventional wind turbines.

20

The present invention provides yet another advantage because it generates a vortex downstream of the at least one rotor (13), the "heart" or "eye" of said vortex being an area wherein the airflow is calm. The generator (23) can be advantageously situated within said "heart" or "eye" so that its position does not affect or alter the
25 upstream air flow. Moreover, the generator (23) is cooled by being placed in the "heart" or "eye" of the vortex. The present invention is also advantageous, in that, due to its innovative design, the at least one rotor (13) and shaft (45) are capable of rotating at speeds of about 5000 revolutions per minute (RPM) and higher, compared to a maximum rotational speed of about 1440 RPM for a generator of conventional

systems known in the art, thus enabling the present invention to generate a greater amount of electrical energy when compared to those conventional systems.

The present invention provides numerous advantages over those systems known in the art, namely in terms of being less harmful to the environment, and being better adapted to operate in cold-climate conditions. First, the preferred screen (75) can be electrified to generate a suitable electromagnetic field about the enclosed inlet (9) in order to prevent or at the very least deter animals (ex. birds) from approaching the assembly (1), or entering the enclosed inlet (9), unlike wide-span rotors of conventional systems which are known to harm birds and/or adversely affect their migratory activities. Secondly, the present invention's rotor (13) is encased within the enclosed casing (5) which prevents birds or other animals from impacting the rotor (13). Finally, the preferred screen (75) can be heated, which provides two advantages over those systems known in the art: first, the heating of the screen (75) allows the present invention to operate in cold weather climates by preventing ice or snow accumulation, and second, the heating of the screen (75) increases the energy of the airflow as it enters the enclosed inlet (9), thus optimizing the desired aerodynamic properties of the airflow and permitting maximum electrical energy extraction. Heating of the screen (75) could be conveniently done by using electricity drawn from the assembly (1) and/or, if need may be, by an auxiliary feeding system which would power the electrified screen (75).

The present invention is also advantageous in that it comprises the casing (5) which eliminates the acoustic and visual pollution associated with conventional devices, further permitting the assembly (1) to be operated near areas of high energy consumption. Moreover, energy generated according to the present invention is non-polluting in that it does not require the combustion of fossil fuels. This provides numerous advantages in that it reduces emissions of greenhouse gases (GHGs) into the atmosphere and helps countries and industries meet their legal commitments in this regard while promoting sustainable industry at the same time. It further reduces

the need to "scrub" emissions from fossil-fuel burning electrical generators, and permits the present invention to be operated near populous cities and towns, areas of high energy consumption, without affecting the air quality for the inhabitants of these cities and towns.

5

The present invention is also advantageous for its simplicity of design. The limited number of components (i.e. rotor (13), a deflector (49), a shaft (45)) eliminate the need for a transmission system, thus reducing the complexity, weight and expensive maintenance associated with the conventional devices known in the art.

10 Maintenance is further reduced because of the presence of sensors (85) for determining the alignment of the shaft (45) and/or other components or characteristics, said sensors (85) alerting a technician to potential issues. Further aiding maintenance is the use of a sleeve (71), which allows a generator (23) to be changed and/or replaced without having to dismantle all the components of the assembly (1), and

15 which is capable of neutralizing the electric, magnetic and/or electromagnetic effects of the generator (23). Moreover, the present invention does not employ brakes to reduce the speed of the rotor blades as is done with conventional devices so as to preserve their structural integrity, as known in the art, thus further reducing weight, cost and complexity. Instead, the present invention employs shutters (47) or other like devices

20 to control or reduce the airflow entering the enclosed inlet (9), said like devices presenting advantages such as easy installation and operation, and very low maintenance costs.

According to another aspect of the present invention, there is provided a laser

25 alignment system for facilitating and monitoring the alignment of the turbine in relation to other components, and for alerting a technician when said alignment deviates a given amount.

As just a simple illustration of the advantages the present invention provides

30 with respect to cost, a typical wind turbine system known in the art uses more than

about 10,000 components whereas the present invention contains less than about 1,000 components. Yet another advantage of the simplicity of the present invention is that it can be manufactured for industrial-sized generation or for individual or private electrical generation (also known as "micro-electrification"), thus rendering the present invention "scalable" and accessible to every segment of the population and to large and small industry. The low cost associated with the present invention enables many assemblies (1) to be installed for the price of a single conventional system while still generating more electrical energy than conventional devices, thus permitting excess generating capacity to be stored or sold for profit.

Furthermore, the present invention is an innovative and a showcase environmental technology which may lead to the creation of highly-skilled employment for thousands of individuals whether in construction, transportation of components, installation, design, mounting of transmission lines, etc. It further presents advantages for those parts of the world where electrical power generation is unreliable and also complements existing electrical power generators which can be used as back-ups when, in the rare cases where wind speeds are too low, the present invention does not generate electrical power. The present invention also easily integrates into the existing electrical energy transmission infrastructure. Based on a study conducted by a collaborator of the Applicant of the present patent application, the present invention reduces the cost of producing electrical energy in the order of about 20% to 25%. With only slight modifications, the encased turbine (1) can be used as an encased or uncased hydraulic turbine (1) in a water environment. Further modeling suggests that the assembly (1) according to the present invention can produce up to 10 times the amount of energy of a typical wind turbine for a given windspeed, and this with the (assembly) being 10 times less voluminous because certain components are eliminated that generate losses (ex. the gear-augmentation from a low-rpm high-torque rotation to a high-rpm low torque generator, etc.).

Furthermore, the assembly (1) according to the present invention is an "upwind" type because the wind hits the inlet (9) before the rotor (13), in contrast to a "downwind" where air is sucked into the inlet because of a vacuum created downstream of the outlet. The assembly (1) is also known as a "direct-drive" assembly
5 (1), which advantageously results in high-rpm at the generator (23).

The starter motor also advantageously cooperates with the assembly (1) so as to kick-start the rotor (13) by inducing a current and/or voltage into the generator/motor so as to provide an initial rotational force when airspeeds are below a certain threshold
10 speed, and for being de-activated when airspeeds are above the threshold speed.

Furthermore, the mounting of an assembly (1) to a moving vehicle can advantageously supplement the supply of electricity to the vehicle. Conventional emergency use devices such as these produce 0.2 W for a 7" diameter device,
15 whereas the assembly (1) can produce about 1.8 W for a 6" diameter device, and it can be installed in a place where drag is not a concern or has already been generated by upstream components (i.e. where wind is wasted).

Of course, numerous modifications could be made to the above-described
20 embodiments without departing from the scope of the invention, as defined in the appended claims.

CLAIMS

1: A turbine assembly (1) for generating electricity from kinetic energy of a moving fluid flow (3), the turbine assembly (1) comprising:

5 an elongated casing (5) defining a fluid channel (7) through which the fluid flow (5) is allowed to travel;

an inlet (9) having an effective cross-sectional area for receiving the fluid flow (3) into the fluid channel (7), the inlet (9) being further configured for directing the fluid flow (3) into said fluid channel (7);

10 an outlet (11) having an effective cross-sectional area for releasing the fluid flow (3) out from the fluid channel (7), the outlet (11) being positioned downstream of the inlet (9) along the fluid channel (7);

a main rotor (13) contained within the casing (5) and intersecting the fluid channel (7), between the inlet (9) and the outlet (11), the main rotor (13) being
15 rotatably moveable with respect to the casing (5) via a pivoting component (15), the main rotor (13) having a closed-loop arrangement (17) provided with a plurality of rotor vanes (19) each defining a neighbouring closed-loop rotor passage (21), the closed-loop rotor passages (21) of the main rotor (13) providing an effective cross-sectional area through which the fluid flow (3) is allowed to pass, the main rotor (13) being
20 rotatably driven via the passage of fluid flow (3) through its closed-loop arrangement (21), and the closed-loop arrangement (21) being further configured for imparting a forced rotational movement to the fluid flow (3) exiting from the main rotor (13); and

a main generator (23) being operatively connectable to the main rotor (13) and being driven by a rotation of said main rotor (13), in order to generate electricity, the
25 main generator (23) being contained within the casing (5) and being positioned within said casing (5) via a supporting component (25) so as to be placed in a vortex region (27) defined by the forced rotational movement of the fluid flow (3) exiting the main rotor (13).

2. A turbine assembly (1) according to claim 1, wherein the closed-loop arrangement (17) of the main rotor (13) comprises concentric inner and outer rings (29,31), the inner ring (29) being provided with a plurality of inner rotor vanes (19a) each defining a neighbouring closed-loop inner rotor passage (21a), the closed-loop
5 inner rotor passages (21a) of the main rotor (13) providing a first effective cross-sectional area through which an inner portion of the fluid flow (3) is allowed to pass, and the outer ring (31) being provided with a plurality of outer rotor vanes (19b) each defining a neighbouring closed-loop outer rotor passage (21b), the closed-loop outer rotor passages (21b) of the main rotor (13) providing a second effective cross-
10 sectional area through which an outer portion of the fluid flow (3) is allowed to pass.
3. A turbine assembly (1) according to claim 2, wherein the inner ring (29) is delimited from the outer ring (31) via a circumferential median wall (33).
- 15 4. A turbine assembly (1) according to claim 3, wherein the closed-loop arrangement (17) is circular having an outer radius(r_1), and wherein the circumferential median wall (33) is also circular and has a radius (r_2) which is about 2/3 of the outer radius (r_1).
- 20 5. A turbine assembly (1) according to claim 4, the outer ring (31) is delimited via a peripheral outer wall (35), and wherein the peripheral outer wall (35) is circular and has a radius (r_1) corresponding to the outer radius (r_1) of the closed-loop arrangement (17).
- 25 6. A turbine assembly (1) according to any one of claims 1-5, wherein outer rotor vanes (19b) of the main rotor (13) have a curved profile different from that of inner rotor vanes (19a) of said main rotor (13).

7. A turbine assembly (1) according to any one of claims 1-6, wherein outer rotor vanes (19b) of the main rotor (13) are radially offset with respect to inner rotor vanes (19a) of said main rotor (13).

5 8. A turbine assembly (1) according to any one of claims 1-7, wherein outer rotor vanes (19b) of the main rotor (13) are radially aligned with respect to inner rotor vanes (19a) of said main rotor (13).

9. A turbine assembly (1) according to any one of claims 1-8, wherein outer rotor
10 vanes (19b) of the main rotor (13) are configured for cooperating with a high-velocity fluid flow (3b), and wherein inner rotor vanes (19a) of said main rotor (13) are configured for cooperating with a low-velocity fluid flow (3a).

10. A turbine assembly (1) according to any one of claims 1-9, wherein the main
15 rotor (13) comprises about ten inner rotor vanes (19a) and about twenty outer rotor vanes (19b).

11. A turbine assembly (1) according to any one of claims 1-10, wherein the turbine assembly (1) further comprises a complementary rotor (13b).

20

12. A turbine assembly (1) according to claim 11, wherein the main rotor (13) and the complementary rotor (13b) are placed side by side within the casing (5) of the turbine assembly (1) so as to form an elongated rotor (13) within said casing (5).

25 13. A turbine assembly (1) according to claim 12, wherein rotor (19) vanes of the complementary rotor (13b) are positioned, shaped and sized rotor with respect to rotor vanes (19) of the main rotor (13) so as to form pairs of neighbouring vanes (19) within the elongated rotor (13), thereby providing a corresponding cupping effect, for an increased rotation of the elongated rotor (13).

30

14. A turbine assembly (1) according to any one of claims 1-13, wherein at least one rotor vane (19) of the turbine assembly (1) is moveable with respect to its corresponding rotor (13) so as to have a variable pitch.

5 15. A turbine assembly (1) according to any claim 14, wherein the variable pitch of said at least one rotor vane (19) is adjustably controllable by a control device (37) of the turbine assembly (1).

10 16. A turbine assembly (1) according to any one of claims 1-15, wherein the turbine assembly (1) comprises a heating component (39) for heating corresponding rotor vanes (19) of a given rotor (13) so as to prevent an accumulation of ice on said corresponding rotor vanes (19).

15 17. A turbine assembly (1) according to any one of claims 1-16, wherein a given rotor (13) of the turbine assembly (1) has a central hub (41) provided with a plurality of through holes (43) for reducing an overall weight of said given rotor (13).

20 18. A turbine assembly (1) according to any one of claims 1-17, wherein each rotor (13) is securely fixed about a rotatable shaft (45) being pivotally mounted within the casing (5) so as to rotate with said rotatable shaft (45).

19. A turbine assembly (1) according to any one of claims 1-18, wherein each rotor (13) is made from 7000 series Aluminum.

25 20. A turbine assembly (1) according to any one of claims 1-19, wherein the turbine assembly (1) comprises at least one adjustable shutter (47) in fluid communication with the inlet (9) and being adjustably operable between opposite opened and closed configurations for adjustably controlling an extent of fluid flow (3) entering the inlet (9),

thereby adjustably controlling an extent of rotational speed of each rotor (13), and in turn adjustably controlling an extent of electricity output of the main generator (23).

21. A turbine assembly (1) according to any one of claims 1-20, wherein the turbine assembly (1) comprises an electromagnetic generator (23b) operatively connected to a given rotor (13) for generating an electromagnetic resistance for adjustably impeding the rotation of said given rotor (13), and in turn adjustably controlling electricity output of the main generator (23).

22. A turbine assembly (1) according to claim 21, wherein the main generator (23) is also the electromagnetic generator (23b).

23. A turbine assembly (1) according to any one of claims 1-22, wherein the inlet (9) is provided with a deflector (49) comprising a plurality of deflector vanes (51) configured for directing the fluid flow (3) downstream at an optimal attacking angle onto the rotor vanes (19) of a given rotor (13).

24. A turbine assembly (1) according to claim 23, wherein the deflector (49) is fixedly mountable within the casing (5).

25. A turbine assembly (1) according to claim 24, wherein the deflector (49) also serves as a structural reinforcement component for the casing (5) for assisting in maintaining an overall structural integrity of said casing (5).

26. A turbine assembly (1) according to any one of claims 23-25, wherein the deflector (49) comprises an orifice (53) for receiving a first distal section (45a) of a rotatable shaft (45) about which each rotor (13) is mounted.

27. A turbine assembly (1) according to any one of claims 23-26, wherein the deflector (49) comprises between about two and about eight deflector vanes (51).

28. A turbine assembly (1) according to any one of claims 23-27, wherein at least one deflector vane (53) of the turbine assembly (1) is moveable with respect to the deflector (49) so as to have a variable pitch.

5

29. A turbine assembly (1) according to claim 28, wherein the variable pitch of said at least one deflector vane (51) is adjustably controllable by a control device (37) of the turbine assembly (1).

10 30. A turbine assembly (1) according to any one of claims 23-29, wherein a deflector vane (51) comprises a leading edge (55) facing toward the inlet (9) for directing the fluid flow (3), the leading edge (55) having a leading angle with respect to the pivoting component (15), and a departing edge (57) facing toward the outlet (11) at which the fluid flow (3) leaves the deflector vane (51), the departing edge (57) having a
15 departing angle with respect to the pivoting component (15), wherein the deflector vane (57) spans between the leading edge (55) and the departing edge (57) so as to form an angled deflector vane (57).

31. A turbine assembly (1) according to claim 30, wherein the fluid flow (3) leaving
20 the deflector vane (57) impacts a corresponding rotor vane (19) at an angle normal to a surface of the rotor vane (19).

32. A turbine assembly (1) according to any one of claims 23-31, wherein the deflector (49) is made from at least one material selected from the group consisting of
25 6000 series aluminum alloys and stainless steel.

33. A turbine assembly (1) according to any one of claims 1-32, wherein the main generator (23) is further positioned coaxially about a longitudinal axis (59) of a segment of the fluid channel (7) so as to be cooled by fluid flow (3) exiting the main
30 rotor (13) and rotating about the main generator (23).

34. A turbine assembly (1) according to any one of claims 1-33, wherein an input shaft (61) of the main generator (23) is operatively connectable to a rotatable shaft (45) supporting the main rotor (13) via a coupling component (63), so that rotation of the input shaft (61) of the main generator (23) is directly proportional to a corresponding rotation of the main rotor (13) of the turbine assembly (1).

35. A turbine assembly (1) according to claim 34, wherein the coupling component (63) comprises a compensatory flexible component (65) for compensating for variations in alignment between the rotatable shaft (45) and the input shaft (61) of the main generator (23).

36. A turbine assembly (1) according to any one of claims 1-35, wherein the turbine assembly (1) comprises a generator support (25c) for supporting the main generator (23), the generator support (25c) being fixedly mountable within the casing (5).

37. A turbine assembly (1) according to claim 36, wherein the generator support (25c) also serves as a structural reinforcement component for the casing (5) for assisting in maintaining an overall structural integrity of said casing (5).

38. A turbine assembly (1) according to claim 36 or 37, wherein the generator support (25c) comprises a central housing (67) for removably housing the main generator (23), and at least one streamlined support arm (69) projecting from said central housing (67) and being operatively connectable onto the casing (5).

39. A turbine assembly (1) according to claim 38, wherein the central housing (67) is provided with an adjustable sleeve (71) for receiving generators (13) of different sizes.

40. A turbine assembly (1) according to claim 39, wherein the adjustable sleeve (71) is configured for providing electromagnetic insulation.

5 41. A turbine assembly (1) according to any one of claims 36-40, wherein the generator support (25c) is made from grade 316 stainless steel.

42. A turbine assembly (1) according to any one of claims 36-41, wherein the generator support (25c) comprises a bracket onto which the main generator (13) is perpendicularly secured.

10

43. A turbine assembly (1) according to any one of claims 1-42, wherein the effective cross-sectional area of the inlet (9) is substantially greater than the effective cross-sectional area of the main rotor (13), for increasing the speed of the fluid flow (3) passing through the main rotor (13) with respect to the speed of the fluid flow (3) entering the inlet (9).

15

44. A turbine assembly (1) according to any one of claims 1-43, wherein the turbine assembly (1) comprises an intake nozzle (73) removably mountable onto the inlet (9) for further increasing the speed of the fluid flow (3) before entering the inlet (9).

20

45. A turbine assembly (1) according to any one of claims 1-44, wherein the casing (5) of the turbine assembly (1) is cylindrical, and wherein the inlet (9) and the outlet (11) are circular.

25 46. A turbine assembly (1) according to any one of claims 1-45, wherein the casing (5) has a length and a radius which are multiples of about 6 inches.

47. A turbine assembly (1) according to any one of claims 1-46, wherein the turbine assembly (1) comprises a heating component (39) for heating the fluid flow (3) passing though the casing (5) for increasing fluidity of said fluid flow (3).

30

48. A turbine assembly (1) according to any one of claims 1-47, wherein the casing (5) is treated with a corrosion-resistant material.

5 49. A turbine assembly (1) according to any one of claims 1-48, wherein the casing (5) is treated with a paint-receptive material.

50. A turbine assembly (1) according to any one of claims 1-49, wherein the casing (5) is made from grade 316 stainless steel.

10

51. A turbine assembly (1) according to any one of claims 1-50, wherein the turbine assembly (1) comprises a first screen (75a) removably mountable within the inlet (9), for preventing undesirable objects present in the fluid flow (3) from entering into the fluid channel (7) within the casing (5) via said inlet (9).

15

52. A turbine assembly (1) according to claim 51, wherein the turbine assembly (1) comprises a second screen (75b) removably mountable within the outlet (11), for preventing undesirable objects near the turbine assembly (1) from entering into the fluid channel (7) within the casing (5) via said outlet (11).

20

53. A turbine assembly (1) according to claim 51 or 52, wherein each screen (75) comprises a total cross-sectional area, and an effective cross-sectional area through which fluid flow is allowed to pass, the effective cross-sectional area of each screen (75) being between about 80% and about 85% of its total cross-sectional area.

25

54. A turbine assembly (1) according to any one of claims 51-53, wherein the effective cross-sectional area of each screen (75) is made of a plurality of apertures (77) having a shape selected from the group consisting of triangular, square, rectangular, polygonal and circular.

30

55. A turbine assembly (1) according to any one of claims 51-54, wherein the turbine assembly (1) comprises a heating component (39) for heating corresponding sections of each screen (75) so as to prevent an accumulation of ice on said corresponding sections of the screen (75).

5

56. A turbine assembly (1) according to any one of claims 1-55, wherein the turbine assembly (1) comprises an animal-detering mechanism (79) for deterring animals from approaching the turbine assembly (1).

10 57. A turbine assembly (1) according to claim 56, wherein the animal-detering mechanism (79) comprises an electromagnetic field produced by a current running through a corresponding screen (75) of the turbine assembly (1).

15 58. A turbine assembly (1) according to claim 57 or 58, wherein the animal-detering mechanism (79) comprises a sound-emitting mechanism (79).

59. A turbine assembly (1) according to claim 58, wherein the sound-emitting mechanism (79) is a high-frequency sound-emitting mechanism provided by a corresponding screen (75) of the turbine assembly (1).

20

60. A turbine assembly (1) according to any one of claims 51-59, wherein each screen (75) is made from a corrosion-resistant material.

25 61. A turbine assembly (1) according to any one of claims 51-60, wherein each screen (75) is made of grade 316 stainless steel.

30 62. A turbine assembly (1) according to any one of claims 1-61, wherein the turbine assembly (1) comprises an entrance cone (81) being removably mountable onto a corresponding supporting component (25), the entrance cone (81) being positioned upstream of the inlet (9) for streamlining fluid flow (3) entering into said inlet (9).

63. A turbine assembly (1) according to claim 62, wherein the corresponding supporting component (25) is a deflector (49) of the turbine assembly (11).

5 64. A turbine assembly (1) according to any one of claims 1-63, wherein the turbine assembly (1) comprises a rotatable shaft (45) pivotably mountable onto at least one corresponding supporting component (25), each rotor (13) being fixedly mountable onto said rotatable shaft (45) so as to rotate therewith.

10 65. A turbine assembly (1) according to claim 64, wherein the rotatable shaft (45) has a first distal section (45a) pivotably mounted onto a first supporting component (25a) fixedly mountable within the casing (5), at the inlet (9).

15 66. A turbine assembly (1) according to claim 65, wherein the said at least one corresponding supporting component (25) includes a deflector (49) of the turbine assembly (1), and wherein the rotatable shaft (45) is pivotably mountable within said deflector (49).

20 67. A turbine assembly (1) according to claim 66, wherein a spacer (83) is provided between the first supporting component (25a) and the deflector (49).

25 68. A turbine assembly (1) according to any one of claims 64-67, wherein the rotatable shaft (45) extends substantially along a longitudinal axis (59) of the fluid channel (7).

30 69. A turbine assembly (1) according to any one of claims 64-68, wherein the rotatable shaft (45) comprises at least two coaxial shafts (45), the first coaxial shaft (45) having a first rotor (13) rotatably mounted thereabout and being connected to a first generator (23), and the second coaxial shaft (45) being mounted concentrically within the first coaxial shaft (45), and having a second rotor (13) rotatably mounted

thereabout and being connected to a second generator (23), wherein each coaxial shaft (45) has a rotational velocity substantially matching a rotational velocity of its corresponding rotor (13).

5 70. A turbine assembly (1) according to any one of claims 64-69, wherein the turbine assembly (1) comprises a sensor (85) for monitoring at least one parameter of each shaft (45).

10 71. A turbine assembly (1) according to claim 70, wherein the at least one parameter is selected from the group consisting of alignment, vibration and rotational velocity.

15 72. A turbine assembly (1) according to any one of claims 64-71, wherein the rotatable shaft (45) comprises different sections of different outer diameters, each of said sections being configured for cooperating with a corresponding component of the turbine assembly (1).

20 73. A turbine assembly (1) according to any one of claims 64-72, wherein the rotatable shaft (45) comprises three different sections, a first distal section (45a) configured for cooperating with a first supporting component (25a), a second distal section (45b) configured for cooperating with the main generator (23), and a middle section (45c) configured for cooperating with the main rotor (13).

25 74. A turbine assembly (1) according to claim 73, wherein the middle section (45c) has a diameter larger than that of the first distal section (45a), and wherein said first distal section (45a) has a diameter larger than that of the second distal section (45b).

75. A turbine assembly (1) according to any one of claims 64-74, wherein the rotatable shaft (45) has a second distal section (45b) pivotably mounted onto a second

supporting component (25b) fixedly mountable within the casing (5), downstream of the inlet (9).

5 76. A turbine assembly (1) according to claim 75, wherein the second supporting component (25b) is positioned within the casing (5) between the main rotor (13) and the main generator (23).

10 77. A turbine assembly (1) according to claim 75 or 76, wherein the second supporting component (25b) comprises a shaft housing (87) for removably housing a segment of a middle section (45c) of the rotatable shaft (45), and at least one streamlined support arm (69) projecting from said shaft housing (87) and being operatively connectable onto the casing (5).

15 78. A turbine assembly (1) according to any one of claims 64-77, wherein each supporting component (25) also serves as a structural reinforcement component for the casing (5) for assisting in maintaining an overall structural integrity of said casing (5).

20 79. A turbine assembly (1) according to any one of claims 64-78, wherein each supporting component (25) is made from grade 316 stainless steel.

25 80. A turbine assembly (1) according to any one of claims 64-79, wherein the rotatable shaft (45) is removably mountable onto a corresponding supporting component (25) via a bearing (89) so as to enable the rotatable shaft (45) to rotate with respect to the corresponding supporting component (25) while allowing said corresponding supporting component (25) to remain stationary.

81. A turbine assembly (1) according to claim 80, wherein the bearing (89) comprises a ball bearing.

82. A turbine assembly (1) according to claim 80 or 81, wherein the bearing (89) has ABEC 7 tolerances.

5 83. A turbine assembly (1) according to any one of claims 80-82, wherein the bearing (89) is made from stainless steel.

84. A turbine assembly (1) according to any one of claims 80-83, wherein the bearing (89) is lubricated.

10 85. A turbine assembly (1) according to any one of claims 1-84, wherein the turbine assembly (1) comprises a starter motor (23c) operatively connected to the rotor (13) for providing an impulsive rotation to said rotor (13) when the fluid flow (3) travelling through the fluid channel (7) is below a given threshold speed.

15 86. A turbine assembly (1) according to claim 85, wherein the main generator (23) is configured to also serve as the starter motor (23c) for the turbine assembly (1).

20 87. A turbine assembly (1) according to any one of claims 1-86, wherein the turbine assembly (1) comprises an auto-positioning mechanism (99) for automatically and continually positioning the inlet (9) to face a direction of greater fluid flow (3).

88. A turbine assembly (1) according to claim 87, wherein the auto-positioning mechanism (99) comprises at least one axis of rotation (91) mountable onto at least one corresponding pivot (93) of the casing.

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89. A turbine assembly (1) according to any one of claims 1-88, wherein the turbine assembly (1) is raised in elevation with respect to a ground surface via a fixed vertical support structure (95).

90. A turbine assembly (1) according to claim 89, wherein the fixed vertical support structure (95) is selected from the group consisting of a pole, rod, pylon, building and ventilation shaft.

5 91. A turbine assembly (1) according to any one of claims 1-88, wherein the turbine assembly (1) is removably mountable onto a moving vehicle for generating electricity from a fluid flow (3) resulting from a displacement of the vehicle.

10 92. A turbine assembly (1) according to claim 91, wherein the turbine assembly (1) is an auxiliary supply of electric energy to a main supply of electric energy of the vehicle.

15 93. A turbine assembly (1) according to any one of claims 1-92, wherein the turbine assembly is part of an array (97) of same turbine assemblies.

94. A turbine assembly (1) according to claim 93, wherein each turbine assembly (1) is placed one above the other.

20 95. A turbine assembly (1) according to claim 93 or 94, wherein each turbine assembly (1) is placed side by side with respect to one another.

25 96. A turbine assembly (1) according to any one of claims 1-95, wherein at least one rotor (13) is concentrically and rotatably mountable about the main generator (23) for generating electricity via a rotation of said at least one rotor (13) about the main generator (23).

30 97. A turbine assembly (1) according to any one of claims 1-96, wherein for each turbine assembly (1), a plurality of rotors (13) are rotatably mounted about corresponding generators (23) and configured in series in the casing (5).

98. A turbine assembly (1) according to any one of claims 1-95, wherein at least one generator (23) encases a corresponding rotor (13) such that rotation of said corresponding rotor (13) induces an electric current in the at least one generator (23) thereby producing electricity.

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99. A kit with components, including an elongated casing (5), an inlet (9), an outlet (11), a main rotor (13) and a main generator (23), configured for assembling with respect to one another, so as to form a turbine assembly (1) such as the one defined in any one of claims 1-98.

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