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US 20120093627 A1 **US 20110142636 A1**
US 20100098552 A1
Vestas V27 blade extenders for sale

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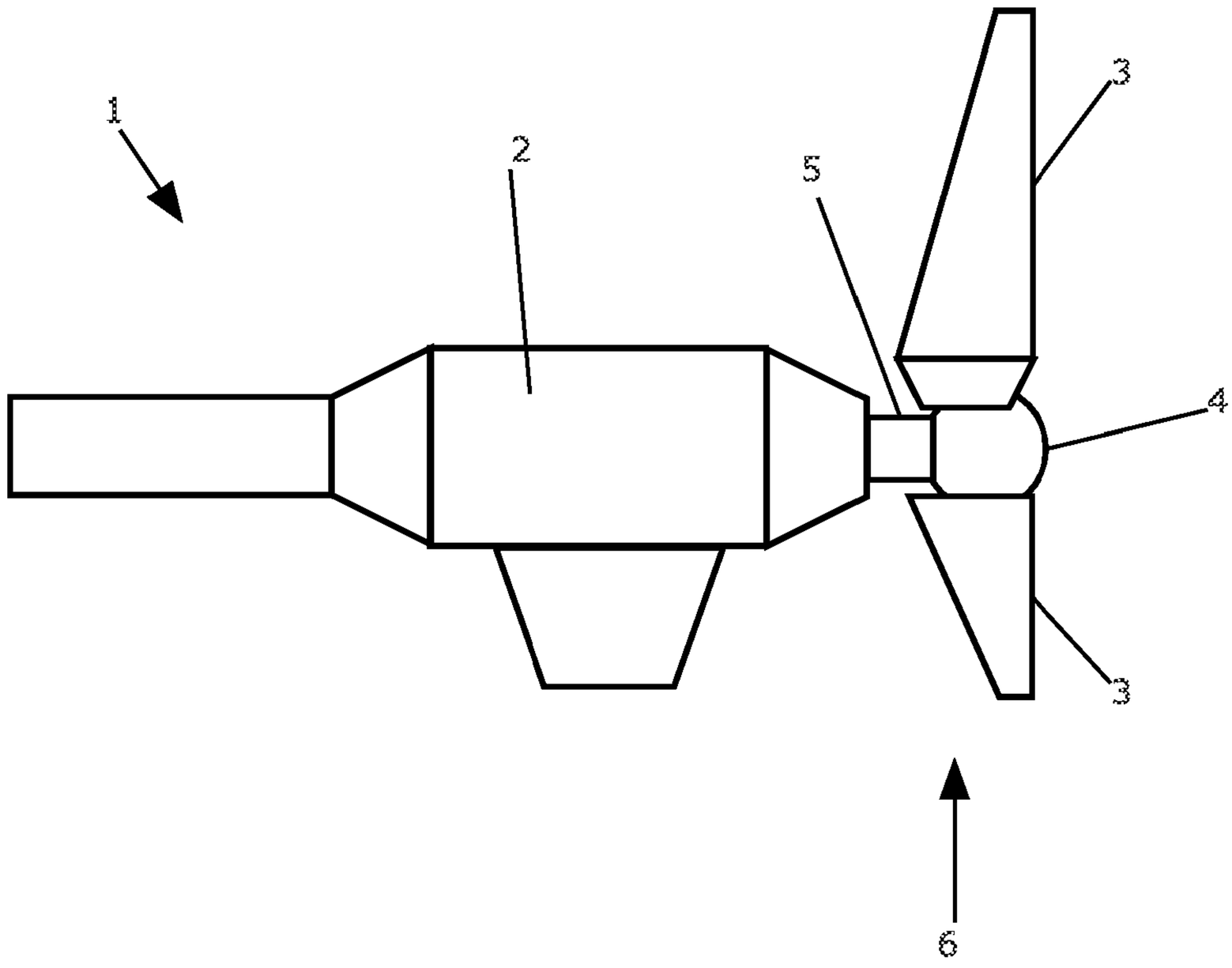

FIGURE 1

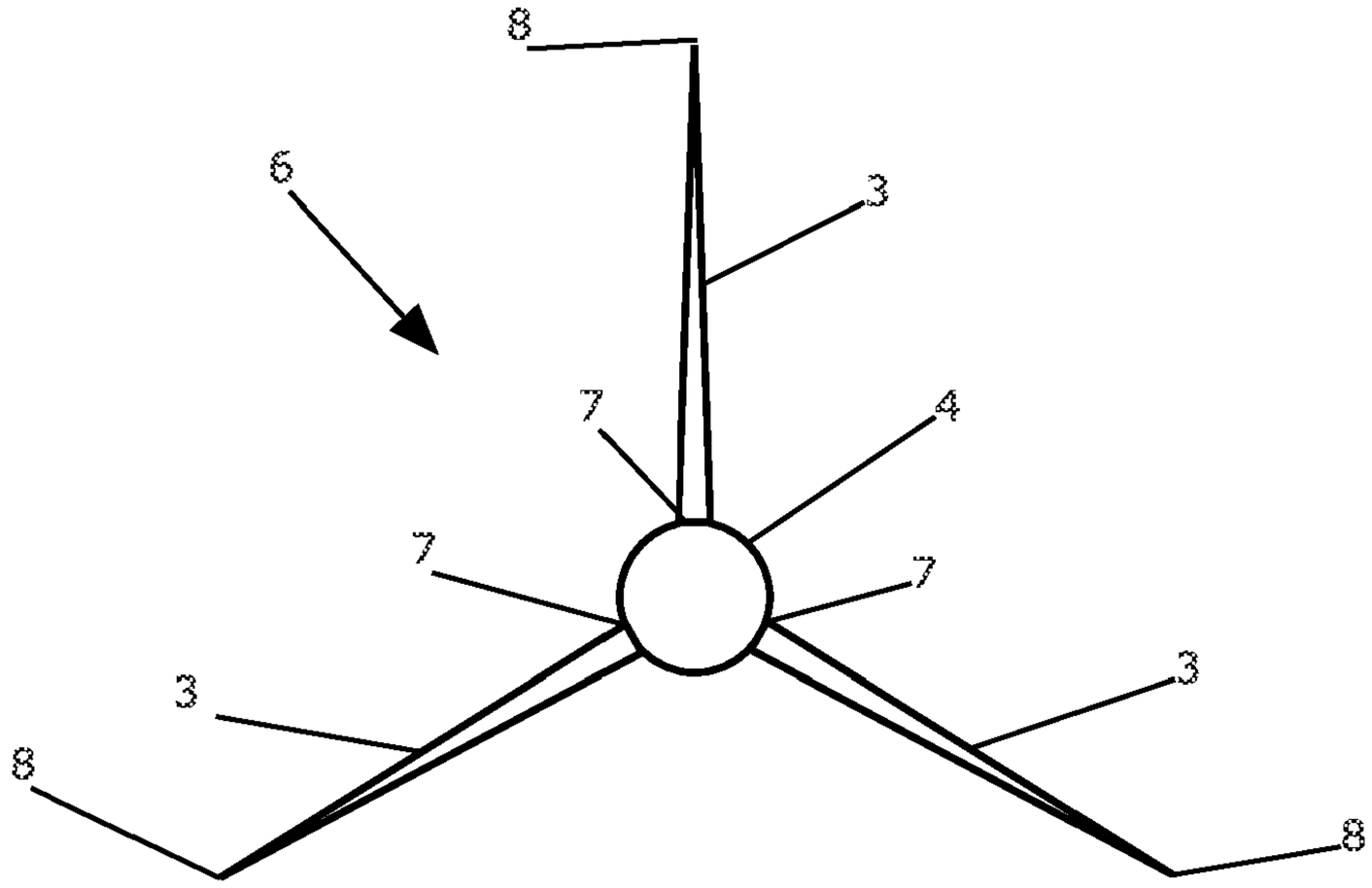

FIGURE 2

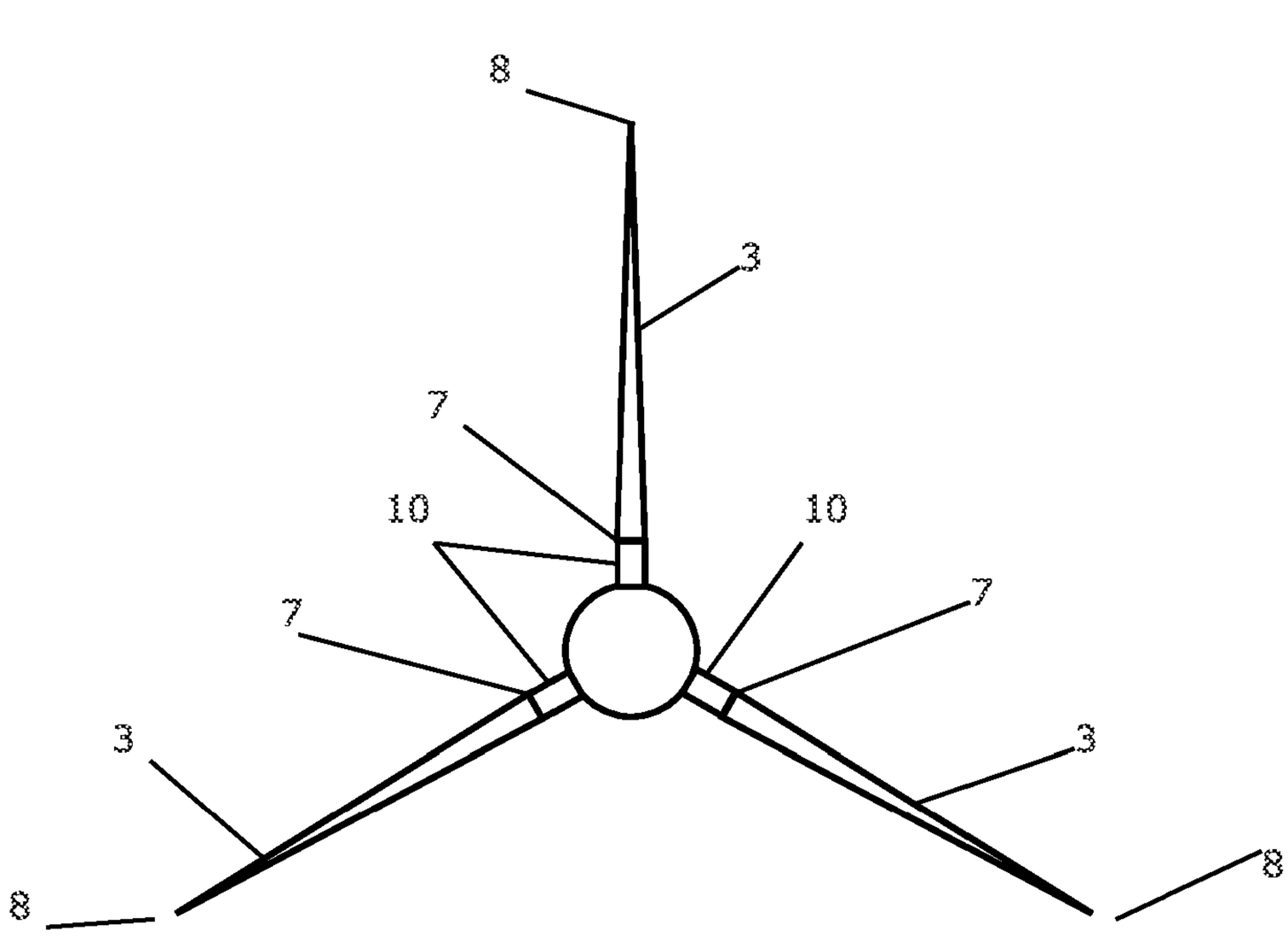

FIGURE 3

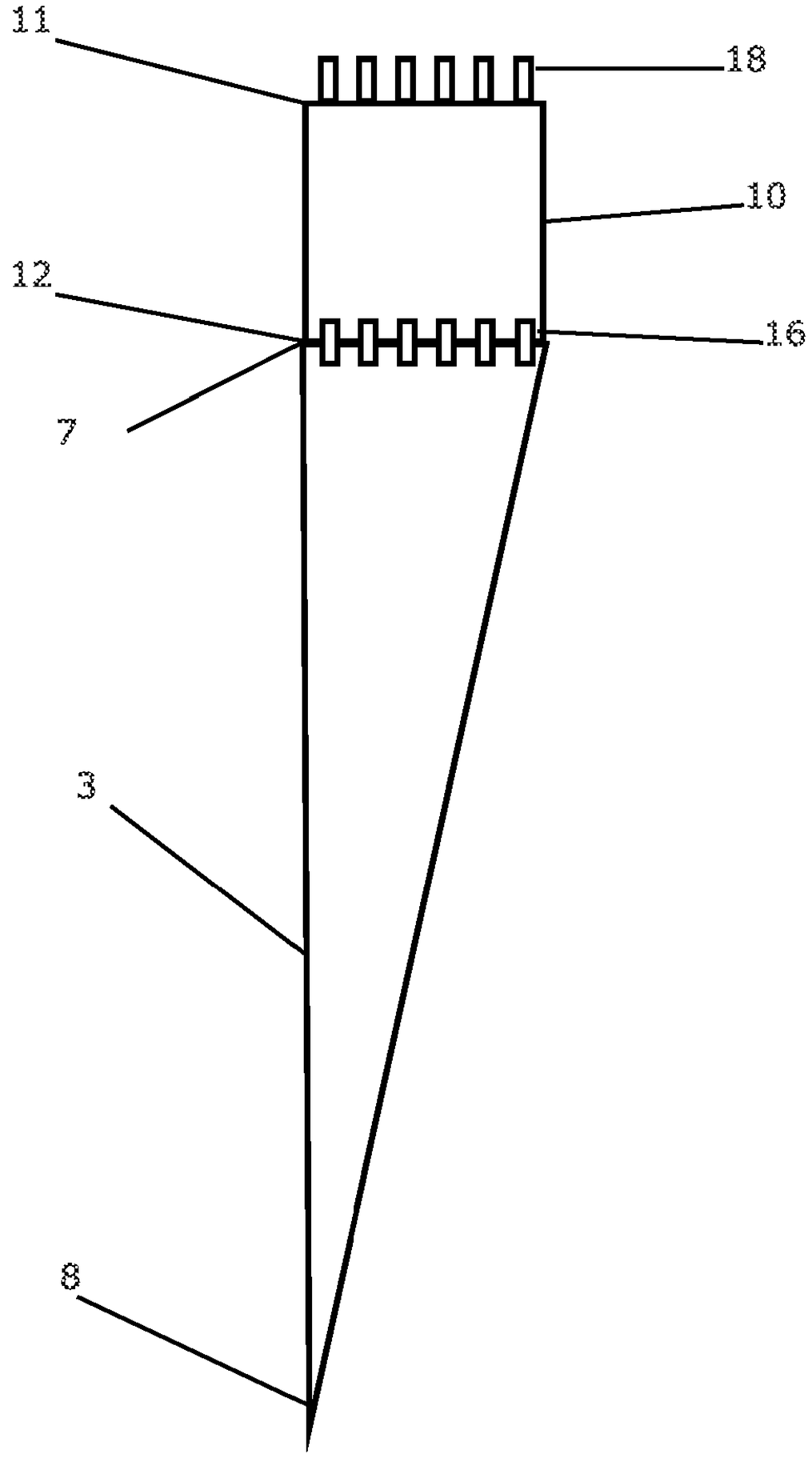

FIGURE 4

ROTOR ASSEMBLIES FOR WATER CURRENT POWER GENERATING SYSTEMS

The present invention relates to rotor assemblies for water current power generating systems.

BACKGROUND OF THE INVENTION

It is widely known that easily accessible resources of fossil fuels are declining. In addition, the impact of the use of fossil fuels upon the environment has become increasingly apparent. As a result of this, it has become imperative that viable alternative energy sources are used as effectively and efficiently as possible. The use of turbines to capture the power of water flow, such as tidal, river and ocean current flows is becoming a viable source of alternative energy. The turbine equipment used to capture such water flow energy typically includes a shaft driven generator connected using a drivetrain to a rotor assembly. The rotor assembly includes a plurality of rotor blades that are driven by the water flow, so as to turn an input shaft of the drivetrain.

It is desirable to provide different sizes of water current turbine, appropriate for different locations, and also to provide for different power generation requirements. Present designs of water current power generating apparatus are designed around a fixed set of parameters. Such design restrictions do not assist in the flexible provision of turbines at reasonable cost.

It is, therefore, desirable to provide a design of turbine that enables provision of different sizes of generating apparatus at reasonable cost.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a method of constructing a water current power generation apparatus as set out by claim 1.

In an example of a water current power generation apparatus, there is provided a rotor blade for a water current power generating apparatus which includes a rotatable hub, the rotor blade comprising a blade portion which extends from a root to a tip of the blade, and which defines a blade profile for the rotor blade, and a hub adaptor which extends from a blade end to a hub end thereof, wherein the hub adaptor is releasably attached at the blade end to the root of the blade portion, and wherein the hub end of the hub adaptor is adapted for releasable attachment to a hub of a water current power generating apparatus, wherein the root of the blade portion defines a blade root fitting, and the blade end of the hub adaptor defines a

blade receiving fitting to which the blade root fitting is releasably attached, and wherein the hub end of the hub adaptor defines a hub attachment fitting for attachment to such a hub, the hub attachment fitting being substantially identical to the blade root fitting.

In one example, the blade root fitting and blade receiving fitting comprise a plurality of securing nut and bolt components.

In another example of a water current power generation apparatus, there is provided a rotor assembly for a water current power generating apparatus, the assembly comprising a hub adapted for attachment to a driveshaft of a water current power generating apparatus, the hub having a first fitting arrangement, a hub adaptor having a hub end and a blade end, and having a second fitting component attached to the first fitting arrangement of the hub, the blade end having a third fitting arrangement, the third fitting arrangement being substantially identical to the first fitting arrangement, and a rotor blade which extends from a root to a tip, the root having a fourth fitting arrangement which is releasably attached to the third fitting arrangement, and which is substantially identical to the second fitting arrangement.

In one example, the first and second fitting arrangements comprise a plurality of securing nut and bolt components.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a water current power generating apparatus;

Figure 2 illustrates a first example rotor assembly for the apparatus of Figure 1;

Figure 3 illustrates a second example rotor assembly for the apparatus of Figure 1; and

Figure 4 illustrates an example rotor blade.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 illustrates a water current power generating apparatus (PGA) 1 comprising an apparatus body 2, a plurality of rotor blades 3 mounted on a rotor hub 4 which is itself mounted on a driveshaft 5. The rotor hub 4 and attached rotor blades 3 form a rotor assembly. The water current PGA 1 is designed to be located underwater, for example, in a tidal body of water. The apparatus body 2 defines an inner space in which electrical power generating equipment is located. The electrical power

generating equipment may include an electrical generator, a gearbox, and control equipment, as appropriate. The electrical power generating equipment is driven by the driveshaft 5 that extends into the apparatus body 2, and which is caused to turn by the rotor assembly. As a water current flows past the power generating apparatus 1, the rotor assembly is caused to rotate with respect to the apparatus body 2 and the equipment contained therein. This rotation causes the hub 4 and driveshaft 5 to rotate, thereby causing the generator to rotate and generate electrical power.

As is well known and understood, the amount of electrical power that is able to be generated by such a water current power generating apparatus is related to the swept area of the rotor assembly 6. This swept area is directly related to the length of the rotor blades 3 from the root to the tip of the blades 3. It is, therefore, desirable to increase the length of the blades wherever possible in order to increase the amount of energy captured by the rotor assembly, and available for conversion into electrical power. It is also desirable to be able to provide different lengths of blades 3 on a common assembly including the body 2, hub 4, driveshaft 5 and electrical generation equipment, such that the power generating apparatus can be used in different conditions. For example, in shallow water, it may be necessary to provide shorter blades than it is possible to provide in deeper water. Presently-considered solutions require the use of different designs of rotor blade 3. It is desirable to be able to use a common blade in different applications.

Figure 2 illustrates an end view of the rotor assembly 6 of Figure 1. The rotor assembly 6 includes a plurality (in this example, three) rotor blades 3 which are attached to respective parts of the hub 4. Each blade has a root 7 and a tip 8. The blade 3 is attached to the hub 4 at the root 7 by way of a root fitting. The root fitting is typically provided by a plurality of bolts which extend through the root 7 into the hub 4. The blade 3 is then secured to the hub using nuts which engage with these bolts. The bolts may extend from the hub 4 or from the blade 3, and the securing nuts are located appropriately on the other component. The bolts may be secured by an appropriate method, such as an adhesive resin. The profile of the blade 3 is carefully designed in order to have the appropriate lift and drag characteristics for the

application for which it is being used. The blade 3 shown in the Figures is merely illustrative, and is not intended to show the profile of a deployable blade.

An embodiment of the present invention provides a hub adaptor which extends the root to tip length of a blade, whilst keeping the remainder of the blade intact. Figure 3 illustrates the provision of a hub adaptor 10 with the blade 3 of Figures 1 and 2. In Figure 3, each rotor blade 3 is attached, at its root 7, to a root adaptor 10. The root adaptor 10 is attached to the hub 4. The root adaptor 10 provides a root fitting for the blade 3, and attaches to the hub 4 using the root fitting previously used for the blade 3. The hub adaptor 10 extends the length of the blade 3, and enables the re-use of a common blade section in different applications.

Figure 4 illustrates a rotor blade 3 and hub adaptor 10 in more detail. Once again, the blade 3 shown in Figure 4 is merely illustrative and is not intended to represent the profile of a deployable blade. It will be appreciated that the present invention relates to the provision of a hub adaptor rather than to the blade itself, and that such a hub adaptor is able to be used with any blade profile.

The blade 3 extends from a blade root 7 to a blade tip 8. The hub adaptor 10 is attached to, and extends from, the root 7 of the blade 3. The hub adaptor 10 has a blade end 12 attached to the root 7 of the blade 3, and has a hub end 14 for attachment to the hub 4 of the power generating apparatus. The hub adaptor 10 extends from the blade end 12 to the hub end 14.

The blade end 12 of the adaptor 12 is provided with a blade root fitting 16 to which the root 7 of the blade is attached. The blade root fitting 16 of the adaptor 10 is of the same construction as that provided by the hub 4, such that the root 7 of the blade 3 is able to be attached to the hub adaptor in the same manner as it would be attached to the hub 4.

Similarly, the hub end 14 of the adaptor 10 is provided with a hub fitting 18 which is of the same configuration as the root fitting of the blade 3, such that the adaptor 10 is able to be attached to the hub 4 in the same manner as the blade 3 is attached to the hub 4. Such a construction enables the hub adaptor to be used without significant changes to the process of fitting the blade to the hub.

The hub adaptor 10 may be of any appropriate length, and may provide the blade with an appropriate orientation of fitting with respect to the hub 4.

The hub adaptor enables the area swept by the blade to be increased without the need for redesign and manufacture of the blade. This means that the turbine system is able to be used to generate more electrical power, whilst using the same blades as for used a smaller deployment. The resulting blade design may not be completely optimised when compared to complete blade of the required length, since the hub adaptor will change the characteristics of the root portion of the blade. However, the increase in swept area, and hence generated power, will offset any losses due to inefficiency in the blade design. In addition, the angle of incidence of the blade can be adjusted by attaching the blade to the hub adaptor in an appropriate position.

CLAIMS:

1. A method of constructing a water current power generation apparatus (PGA), comprising the steps of:

selecting an underwater location for the water current PGA, wherein the water current PGA comprises an apparatus body and a plurality of rotor blades mounted on a rotor hub, wherein the rotor hub is mounted to a driveshaft;

selecting hub adapters, between the rotor hub and the rotor blades, based on the depth of the water at the selected underwater location;

providing a water current PGA at the selected underwater location, with the selected hub adapters between the rotor hub and the rotor blades; and thereafter,

providing a further water current PGA at a different underwater location; wherein

the further water current PGA comprises a further plurality of rotor blades mounted on a further rotor hub, and further hub adapters, the further hub adapters being different to the hub adapters and selected based on the depth of the water at the different underwater location; and

the plurality of rotor blades and the further plurality of rotor blades are in accordance with a common blade design.