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(54) WIND TURBINE WITH VERTICAL AXIS

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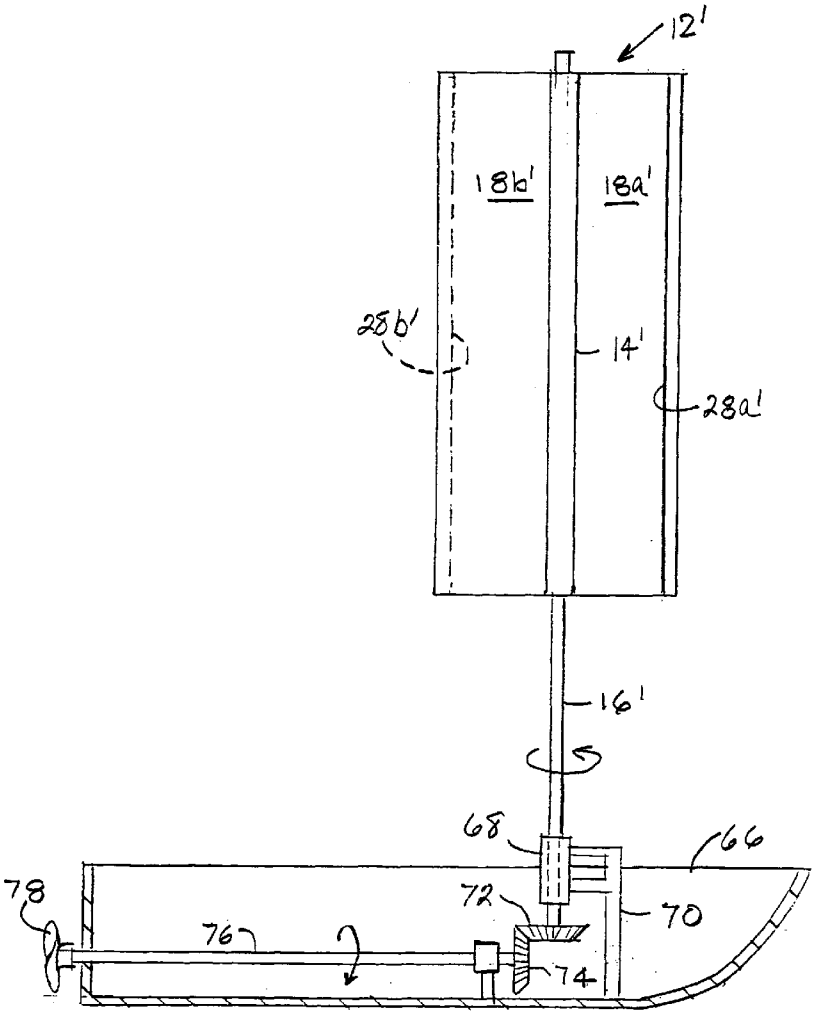
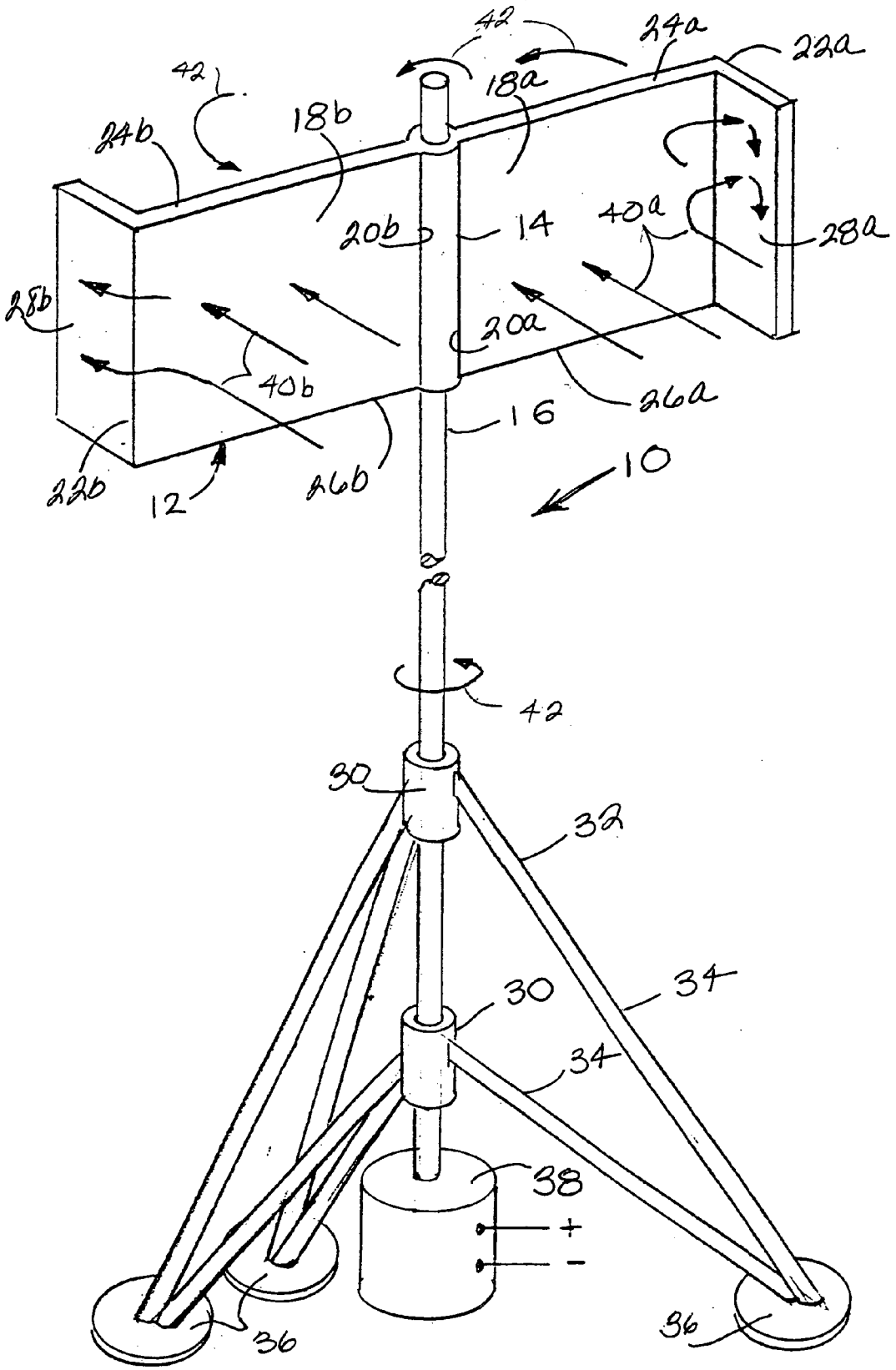
(57) ABSTRACT

A wind turbine having a rotor which rotates in a horizontal plane about a vertical axis to produce power to an electric generator, a propeller driven boat, or other mechanical apparatus. The turbine mounted on a vertical shaft has a plurality of vanes attached to the shaft either directly or through a hub surrounding the shaft. The vanes extend radially outwardly from the shaft and are spaced at equal distances from each other around the shaft. Each vane has a wind responsive flange mounted at its radially outer edge and extending substantially perpendicular to a surface of the vane. Each flange of each vane extends in the same circumferential direction around the rotor. As wind blows against any vane when the flange is facing in the windward direction, the vane tends to contain wind striking that vane and create a greater force than the wind striking the vanes with the flanges facing away from the wind. The different amounts of force striking different vanes causes the rotor to turn either clockwise or counterclockwise, depending upon which circumferential direction the wind responsive flanges are positioned on the vanes. The turning of the rotor also turns the shaft which provides power to a generator or to any other device it is connected to.




42
24a
22a
42
18a
18b
24b
20b
14
40a
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28b
20a
40b
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22b
12
26b
10
42
30
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34
34
38
+
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36
36

FIG. 1

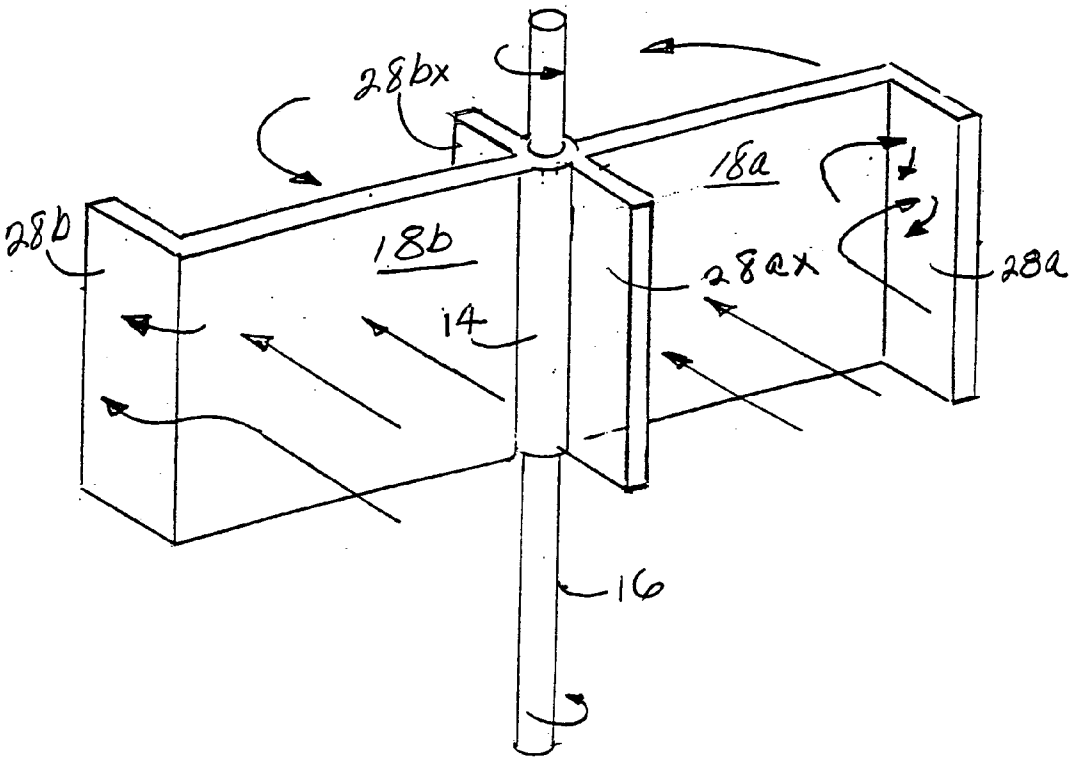
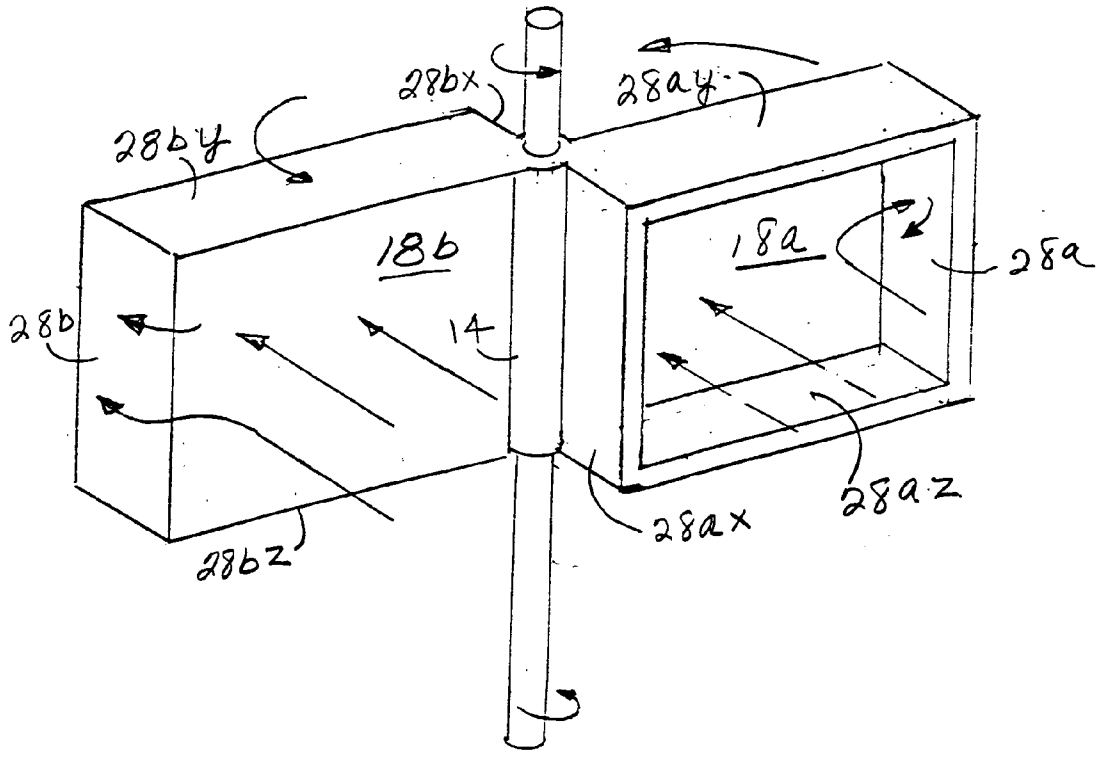

28bx
18a
28b
18b
28ax
28a
14
16

FIG. 2


28bx
28ay
28by
18b
18a
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28b
14
28az
28ax
28bz

FIG. 3

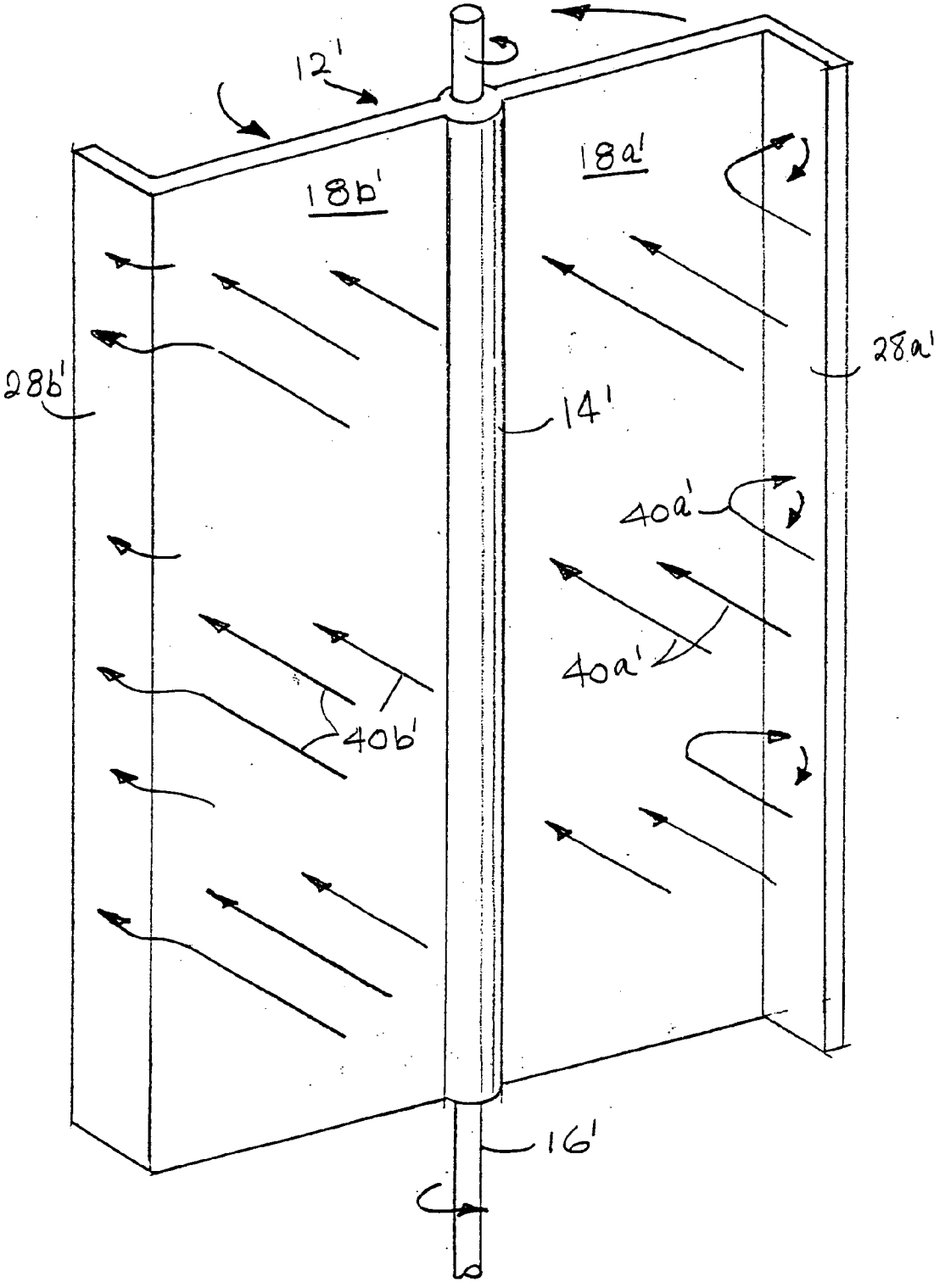

FIG. 4

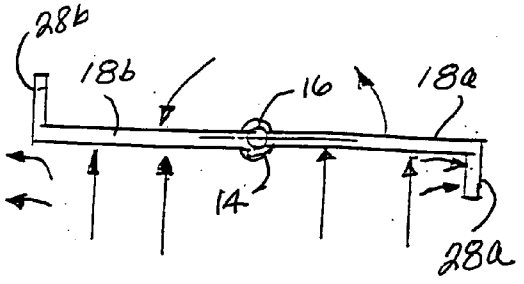

FIG. 5

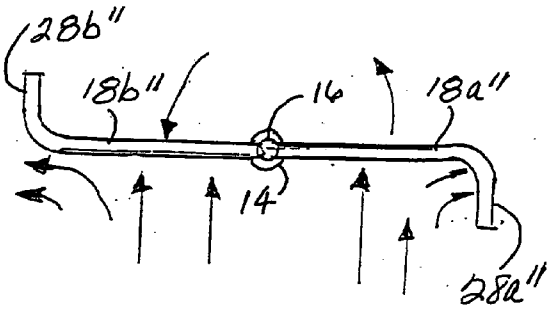

FIG. 6

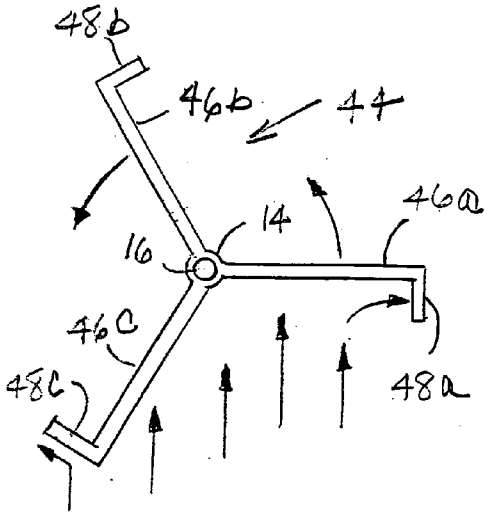

FIG. 7

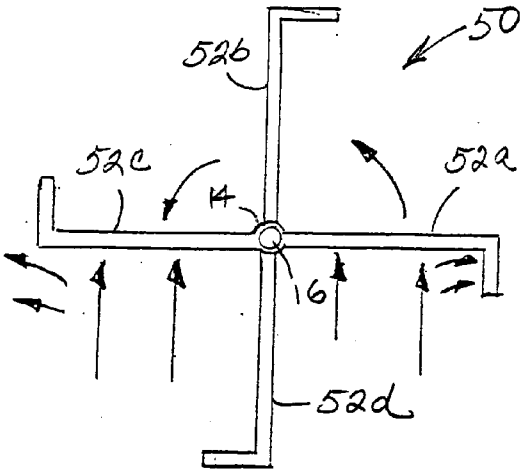

FIG. 8

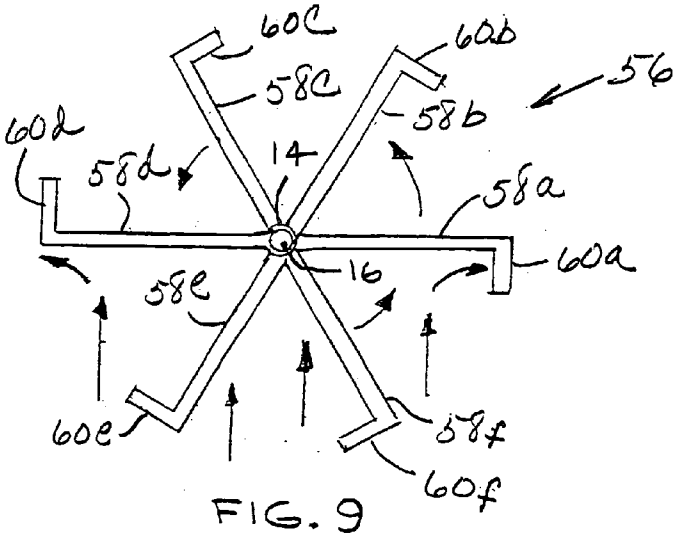

FIG. 9

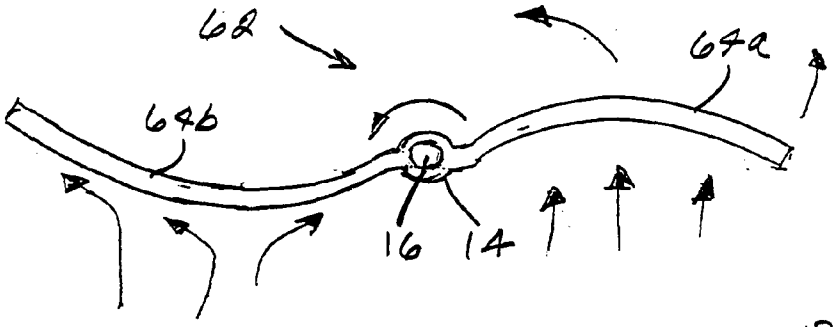

FIG. 10

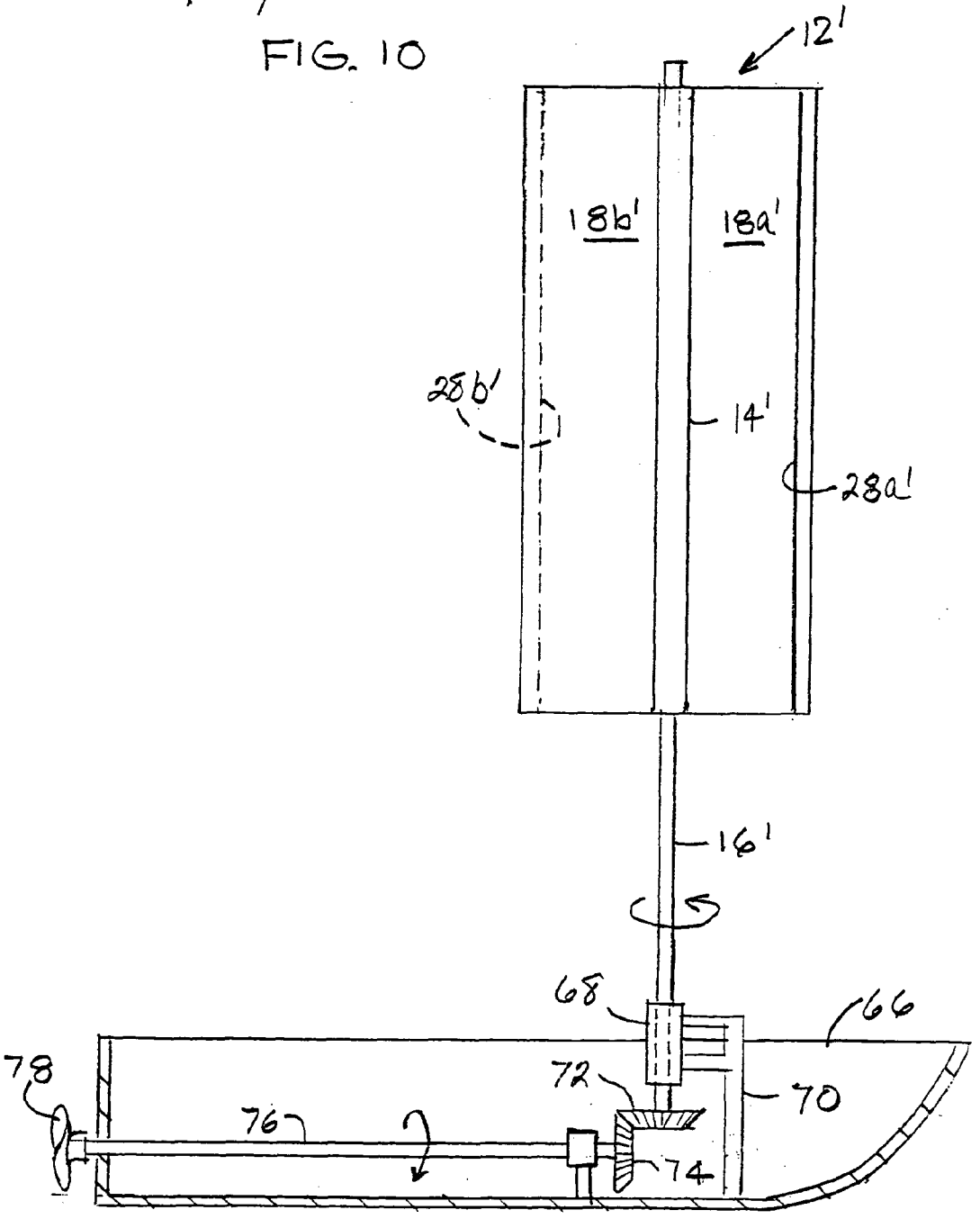

FIG. 11

WIND TURBINE WITH VERTICAL AXIS

FIELD OF THE INVENTION

[0001] This invention relates to a wind turbine having a rotor which rotates in a horizontal plane about a vertical axis to provide power for driving an electric generator or a drive shaft of a propeller of a boat.

BACKGROUND OF THE INVENTION

[0002] Windmills of various designs are well known in the prior art. Windmills having vertical shafts and having horizontally rotating vanes are also well known, however many such windmills are rather complex and require the use of louvers or flaps which open to allow the wind to pass through the vanes when they are in one position with respect to the direction of wind flow and which close to prevent the wind from passing through the vanes when they are in the opposite position with respect to the direction of wind flow.

[0003] Typical examples of such windmills or water driven flow motors are shown in U.S. Pat. No. 3,920,354 (Decker), U.S. Pat. No. 4,134,710 (Atherton) and U.S. Pat. No. 4,684,817 (Goldwater) all of which show various types of flaps or louvers to control the wind-flow through the vanes depending upon their relative location with respect to the direction of the wind acting upon the vanes or in the case of the Atherton patent the flaps control the water flow through the vanes.

[0004] The present invention provides a simpler construction without the need for louvers or other moving parts on the vanes.

[0005] The wind turbine of this invention can be used to provide power to drive electric generators or other types of machinery as well as a source of power to drive the propeller of a boat. This wind rotor when coupled to a boat propeller replaces the various kinds of conventional sails which are normally used on sailboats while enabling the boat to travel directly into the wind or in more different directions than the conventional sailboat. Conventional sailboats require a series of 45 degree tacks which nearly double the time of travel as compared to the time needed when using a wind rotor rather than a conventional sail. Furthermore since this wind rotor turns when receiving the force of the wind it does not cause the boat to tip over as in the case of a conventional sail when the wind is blowing sideways against the sail.

SUMMARY OF THE INVENTION

[0006] The invention as claimed herein is a wind turbine having a rotor which rotates in a horizontal plane about a vertical axis to provide power to an electric generator, a propeller driven boat or other mechanical apparatus, the turbine comprising: a vertical shaft rotatably attached to a fixed support means; a plurality of substantially planar vanes, each vane having a radially inner edge, a radially outer edge, and a top and bottom edge, each vane having its radially inner edge secured to the shaft and extending radially outwardly therefrom in different directions from the other vanes; a wind responsive flange at the radially outer edge of each vane and extending from one face of each vane at a substantially right angle thereto, the flange of each vane extending in the same circumferential direction as the flanges of the other vanes; the flange of each vane partially confining the wind flow against its respective vane when the flange is facing in the windward direction and thereby causing a greater wind force concentration against that vane than against the other vanes when their flanges are facing away from the wind, thereby causing the rotor and shaft to rotate in a given horizontal direction due to the difference in wind force against each of the vanes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIG. 1** is a simple perspective view of one embodiment the invention;

[0008] **FIG. 2** is a perspective view of another embodiment of a rotor of the invention;

[0009] **FIG. 3** is a perspective view of still another embodiment of a rotor of the invention;

[0010] **FIG. 4** is a perspective view of a rotor similar to the embodiment shown in **FIG. 1** but being longer in the vertical direction than in the horizontal direction;

[0011] **FIG. 5** is a top plan view of the rotor shown in **FIG. 1**;

[0012] **FIGS. 6 through 10** are top plan views of other embodiments of rotors each having a different number of vanes from the other rotors; and

[0013] **FIG. 11** is a diagrammatic side view of a rotor similar to that shown in **FIG. 4** used to generate power to drive a boat by means of a propeller.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Referring to **FIGS. 1 and 5** of the drawings, a complete wind turbine assembly is indicated by the numeral **10**. The turbine **10** has a rotor **12**, having a hub **14** mounted on a vertical shaft **16** to rotate therewith.

[0015] The rotor **12** has a pair of vanes **18***a* and **18***b* extending in radially opposite directions from the hub **14**. The vanes **18***a* and **18***b* respectively have radially inner edges **20***a* and **20***b*, radially outer edges **22***a* and **22***b*, upper edges **24***a* and **24***b*, and lower edges **26***a* and **26***b*.

[0016] A flange **28***a* substantially perpendicular to the vane **18***a* extends from the radially outer edge **22***a*. Likewise a flange **28***b* substantially perpendicular to the vane **18***b* extends from the radially outer edge **22***b*.

[0017] The rotor **12** can be made of metal molded plastic or any other suitable material and is fixedly attached on the shaft **16** so that it rotates with the shaft as previously mentioned.

[0018] The lower end of the shaft extends through sleeves or bearings **30** which are mounted on a support frame **32**, having elongated frame members **34** which are attached to base anchors **36** which are securely attached to the ground or other base surface by any known fastening means (not shown).

[0019] The shaft **16** has an output end which is attached to an electric generator **38** to turn the generator and produce electric power. The shaft **16** can be connected either directly to the rotor of the generator as show or can be connected

through conventional gearing and/or an on/off clutch to control the operation of the generator regardless of the rotation of the shaft **16**.

[**0020**] Arrows **40***a* shows the direction of the wind flow against the vane **18***a* where it is partially confined by the flange **28***a*. Since the flange **28***b* faces away from the windward direction, the wind flow against van **18***b* shown by arrows **40***b* is not contained in the same way as the wind flow against vane **18***a*. This partial containment of the wind flow causes a greater build up of force against vane **18***a* and thereby causes the rotor **12** and shaft **16** to rotate in a counterclockwise direction as shown by arrows **42**. It can be recognized that if the flanges **28***a* and **28***b* extend in the opposite circumferential direction from that shown in **FIG. 1**, the rotor will instead rotate in the clockwise direction. The choice of direction of rotation may vary depending upon the apparatus that the rotor is to be used with.

[**0021**] Referring now to **FIG. 2**, it can be seen that the embodiment in **FIG. 1** may be further modified by placing an additional flange **28***ax* or **28***bx* on the radially inner end of each vane **18***a* and **18***b* which is substantially identical to the flanges **28***a* and **28***b* on the outer end of the vanes.

[**0022**] As shown in **FIG. 3**, flanges **28***a*, **28***ax*, **28***ay* and **28***z* or **28***b*, **28***bx*, **28***by* and **28***bz* can extend from all four edges of the vanes **18***a* and **18***b*. When four flanges are used as shown, this in effect, forms a box in conjunction with each vane.

[**0023**] The variations shown in **FIGS. 2 and 3** may tend to further confine the wind striking the surface of the vane and provide greater driving force against the vanes to turn the rotor.

[**0024**] **FIG. 4** shows a rotor **12'** similar to the rotor **12** in **FIG. 1**, except that the vanes **18***a'* and **18***b'* are longer in the vertical direction than in the horizontal direction. The vanes **18***a'* and **18***b'* are attached to a hub **14'** which in turn is mounted in a fixed position on a shaft **16'** to rotate therewith. The rotor **12'** can be mounted on a support from similar to that shown in **FIG. 1** or it can be mounted on a boat as will later be described in and shown in **FIG. 11**. As can be seen from the arrows **40***a'* and **40***b'* the flow of the wind striking the vanes **18***a'* and **18***b'* and the reaction with the flanges **28***a'* and **28***b'* is similar to that show in **FIG. 1**, except that the vanes **18***a'* and **18***b'* present a larger reaction surface than those in **FIG. 1**.

[**0025**] **FIG. 6** is a modification of **FIG. 5** wherein the vanes **18***a"* and **18***b"* curve into the flanges **28***a"* and **28***b"* instead of meeting a right angle corners such as those shown in **FIG. 5**. The reaction of the wind striking the vanes and flanges are essentially the same as that in the version shown in **FIG. 5**.

[**0026**] **FIG. 7** shows a rotor **44** having a hub **14** mounted on a shaft **16**. Mounted on the hub **14** are three vanes **46***a*, **46***b* and **46***c* which are located at 120 degree angles from each other. The three vanes respectively have flanges **48***a*, **48***b* and **48***c* extending form the radially outer edge of it respective vane with all three vanes extending in the same circumferential direction.

[**0027**] **FIG. 8** shows a rotor **50** similar to the rotor **44**, except that it has four vanes **52***a*, **52***b*, **52***c*, and **52***d* instead of three vanes. Each of these vanes are at 90 degree angles from the next adjacent vanes on either side. The vanes are mounted on a hub **14** which in turn is mounted on a shaft **16**. Connected to the respective vanes are flanges **54***a*, **54***b*, **54***c* and **54***d*.

[**0028**] **FIG. 9** shows a rotor **56** having six vanes **58***a*, **58***b*, **58***c*, **58***d*, **58***e* and **58***f* connected to a hub **14** mounted on a shaft **16**. These six vanes are at sixty degree angles to the next adjacent vane on either side. Each of the respective vanes has a respective flange **60***a*, **60***b*, **60***c*, **60***d*, **60***e* and **60***f*.

[**0029**] **FIGS. 7 through 9** are similar to the embodiment in **FIG. 1** except that a different number of vanes are shown in each of these embodiments. Depending upon the application the rotor is being used for, in some instances it may be more effective to use a small number of vanes and in some applications a larger number of vanes may be preferable.

[**0030**] **FIG. 10** shows a different embodiment in which a rotor **62** has a pair of vanes **64***a* and **64***b* mounted on a hub **14** which is mounted on a shaft **16**. Instead of having a flange at the radially outer end of the vanes, the vanes are each concave on one face and convex on the opposite face. The concave side of the vane which faces the windward side tends to confine the wind blowing against the vane **64***a*, whereas the wind striking the convex side of the vane **64***b* tends to deflect the wind thereby causing a greater pressure on vane **64***a* and causing the rotor **62** to rotate in a clockwise direction. This tends to provide the same result as using a flange at the radially outer end of the vane.

[**0031**] **FIG. 11** shows a diagrammatic view of a boat **66** driven by a rotor **12'** similar to that shown in **FIG. 4**. The rotor **12'** is mounted on a shaft **16'** which is rotatably mounted in a sleeve or gear **68** mounted on a support frame **70** which in turn is fastened to the boat **66**. The lower end of the shaft **16'** carries a bevel gear **72** which meshes with a bevel gear **74** mounted on the inner end of a propeller shaft **76** carrying a propeller **78** on its outer end. As the rotor **12'** is turned by the wind, it turns bevel gears **72** and **74**, thereby turning the propeller shaft **76** and the propeller **78** and moving the boat forward.

[**0032**] It can be recognized that by including conventional clutches and additional gearing, the propeller can be caused to move the boat forward or in reverse or stop the propeller or change the propeller speed without regard to the speed of rotation of the rotor **12'**.

[**0033**] As long a there is any wind blowing, the rotor will turn regardless of the direction of the wind in relation to the direction the boat is heading. Unlike a conventional sail boat there is no need to use 45 degree angle tacks to compensate for the difference between the wind direction and the direction which the boat is heading. Furthermore the since the rotor does not respond to the wind in the same way as a conventional sail, there is less likelihood of the boat being capsized by being struck sideways by the wind. The rotor, instead of resisting the wind as would a conventional sail, is turned by the wind and allows the wind to pass around the rotor with less sideways pressure acting against the shaft to tend to capsize the boat.

[**0034**] It should be recognized that the particular configuration of the rotor including the size and the number of vanes

used will depend upon the particular type and size of boat or other mechanical apparatus that is being powered by the rotor.

[0035] Various other modification can be made herein without departing from the scope of the invention.

What is claimed is:

1. A wind turbine having a rotor which rotates in a horizontal plane about a vertical axis comprising:

a vertical shaft rotatably attached to a fixed support means;

at least one pair of substantially planar vanes, each vane of each pair having a radially inner edge, a radially outer edge, and a top and bottom edge, each vane having its radially inner edge secured to the shaft and extending radially outwardly therefrom in opposite directions from the other vane;

a wind responsive flange at the radially outer edge of each vane and extending from one face of each vane at a substantially right angle thereto, the flange of one of each pair of vanes extending in an opposite direction to the other flange of the same pair of vanes;

the flange of each vane partially confining the wind flow against its respective vane when the flange is facing in the windward direction and thereby causing a greater wind force concentration against that vane than against the opposite vane in which its flange is facing away from the wind, thereby causing the rotor and shaft to rotate in a given horizontal direction due to the difference in wind force against each vane of each pair.

2. A wind turbine as claimed in claim 1 wherein the radially inner edge of each vane is fastened to a hub which is mounted on the vertical shaft to rotate therewith.

3. A wind turbine as claimed in claim 1 wherein there are two pairs of vanes with each pair being at a 900 angle to the other pair.

4. A wind turbine as claimed in claim 1 wherein there are three pairs of vanes with each pair of vanes being at a 60° angle to the next adjacent pair of vanes on either side.

5. A wind turbine as claimed in claim 1 including a wind responsive flange at the radially inner edge of each vane extending at substantially right angles to the vane in the same direction from the respective vane as the wind responsive flange at the radially outer edge of the vane.

6. A wind turbine as claimed in claim 1 including a wind responsive flange at both the top and bottom edge of each vane extending at substantially right angles to the vane in the same direction from the respective vane as the wind responsive flange at the radially outer edge of the vane.

7. A wind turbine as claimed in claim 1 wherein the vanes are concave on one side and convex on the other side and wherein one vane of each pair of vanes has its concave and convex sides facing in the opposite direction from the concave and convex sides on the other vane of the pair.

8. A wind turbine as claimed in claim 1 wherein each vane curves around a radius at its radially outer edge to merge into the wind responsive flange.

9. A wind turbine as claimed in claim 1 wherein the vertical shaft is operatively connected to an electrical generator.

10. A wind turbine as claimed in claim 1 wherein the vertical shaft is operatively connected to a propeller shaft of a boat

11. A wind turbine having a rotor which rotates in a horizontal plane about a vertical axis comprising:

a vertical shaft rotatably attached to a fixed support means;

at least one pair of substantially rectangular vanes, each vane of each pair having a radially inner end and a radially outer end, each vane having its radially inner end secured to the shaft and extending radially outwardly therefrom in opposite directions from the other vane;

a portion of each radially outer end of each flange being folded along a vertical line to form a wind responsive flange at the radially outer end of each vane and extending from one face of each vane at a substantially right angle thereto, the flange of one of each pair of vanes extending in an opposite direction to the other flange of the same pair of vanes;

the flange of each vane partially confining the wind flow against its respective vane when the flange is facing in the windward direction and thereby causing a greater wind force concentration against that vane than against the opposite vane in which its flange is facing away from the wind, thereby causing the rotor and shaft to rotate in a given horizontal direction due to the difference in wind force against each vane of each pair.

12. A wind turbine as claimed in claim 11 wherein the radially inner end of each vane is fastened to a hub which is mounted on the vertical shaft to rotate therewith.

13. A wind turbine as claimed in claim 11 wherein there are two pairs of vanes with each pair being at a 900 angle to the other pair.

14. A wind turbine as claimed in claim 11 wherein there are three pairs of vanes with each pair of vanes being at a 600 angle to the next adjacent pair of vanes on either side.

15. A wind turbine as claimed in claim 11 wherein each vane is longer in the vertical direction than in the horizontal direction.

16. A wind turbine as claimed in claim 11 wherein the vertical shaft is operatively connected to an electrical generator.

17. A wind turbine as claimed in claim 11 wherein the vertical shaft is operatively connected to a propeller shaft of a boat.

18. A wind turbine having a rotor which rotates in a horizontal plane about a vertical axis comprising:

a vertical shaft rotatably attached to a fixed support means;

a plurality of substantially planar vanes, each vane having a radially inner edge, a radially outer edge, and a top and bottom edge, each vane having its radially inner edge secured to the shaft and extending radially outwardly therefrom in different directions from the other vanes;

a wind responsive flange at the radially outer edge of each vane and extending from one face of each vane at a substantially right angle thereto, the flange of each of vanes extending in the same circumferential direction as the flanges of the other vanes;

the flange of each vane partially confining the wind flow against its respective vane when the flange is facing in the windward direction and thereby causing a greater wind force concentration against that vane than against the other vanes when their flanges are facing away from the wind, thereby causing the rotor and shaft to rotate in a given horizontal direction due to the difference in wind force against each of the vanes.

19. A wind turbine as claimed in claim 18 wherein the radially inner edge of each vane is fastened to a hub which is mounted on the vertical shaft to rotate therewith.

20. A wind turbine as claimed in claim 18 wherein there are three vanes with each vane being at a 120° angle to the other vanes.

21. A wind turbine as claimed in claim 18 wherein the vertical shaft is operatively connected to an electrical generator.

22. A wind turbine as claimed in claim 18 wherein the vertical shaft is operatively connected to a propeller shaft of a boat.

* * * * *