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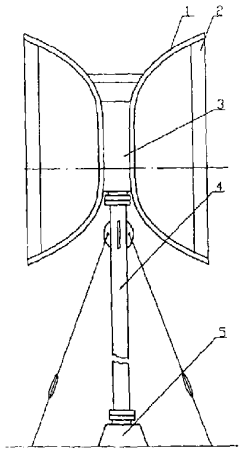
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(54) Title: WINDMILL

(54) 发明名称: 框架组合式风车



(57) Abstract: A windmill comprises a tower and meas for obtaining power from wind which is mounted on the top of the tower. The means for obtaining power from wind comprises a rotor and STS-energy-exchanging-coupling-elements, in which an electromagnetic element as an stationary electric element is fixed in the tower and a magnetic element is combined with the rotor to form a moving assembly. Each blade is supported at its two ends on a bow shaped frame and is aerodynamically similar to a wing of an air sailer so that a tangential force that makes the blade to rotate may be obtained at the middle part of the blade. By means of STS,the speed of the rotor can be automatically adjusted to match the speed of the energy exchanger and to keep the optimal efficiency.

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(57) 摘要

一种框架组合式风车，由柱式塔架以及设于塔架顶端的风力动力元件组成，风力动力元件包括风动转子和 STS 换能偶件组合而成，其中 STS 换能偶件中的电磁元件安装于支架上成为电子静止组件，磁性元件与风动转子组合成为机械运动组件；风动转子的弦翼则由弓形框架支撑垂直连接于弓形框架的弦端。本发明的弦翼采用接近于滑翔机机翼的空气动力学原理，使弦翼腹部可获得使转子顺运动方向转动的切向分力，有利于提高风能的利用效率。通过 STS 赋于风动转子人工智能，能根据风速的改变而自动调整风动转子与换能器之间的速度匹配，随时保证最有利动态响应，使本发明适合于低风速条件下的分布式发电。

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WINDMILL

Pertinent Realm

This invention involves wind power generation equipment. More specifically, it is a framework composition windmill.

Technological Background

Wind power is one of ideal green energies. It is inexhaustible, particularly in the case of generating electricity. The primary working principle of electricity generation through wind power is to utilize wind power to drive wind-driven rotors, such as the blades of a windmill, which then in turn drive the rotation of an electrical generator, thereby transforming the mechanical energy into electrical energy. Although the principle of electricity generation through wind power is extremely simple, its application in actual processes is very limited. Current statistical data shows that, even in a relatively developed wind power generating country such as the United States, wind power generation only makes up for a very small proportion of the total amount of electricity generated. The most significant reason for this is that wind power is an extremely unstable energy source. For example, the 65-kilowatt wind power generation equipment used in California's Altamont Pass, a concentrated wind power site in the United States, have 48-foot diameter rotors and a designed wind speed of 35 mph. Their average cost per kilowatt hour is approximately US$0.05. If, however, this wind power generation equipment were installed in any other region, there would be changes in the triangular relationship between the decreased effective wind speed, the cost effectiveness, and the wind speed. If it is used in an area of distribution type wind power, the technical and economic instruction standards would decrease to a level that would make it difficult to meet the consumer's needs. When wind power device being used in the Xilin pasture lands of Inner Mongolia, for example, the average wind speed in July each year drops to 6.3 mph, and the original 65 kilowatt power rating equipment drops to 0.4 kilowatts. Actually, in the areas with the richest wind power resources in China, the average annual wind speed is only 10 mph. Because China is a country with limited wind power resources, the existing wind power generation equipment described above are not suited in this region.

In summary, the main reason that wind power generation cannot be commercially adopted over a large area is that the design parameters for each wind power generation device are determined according to general environmental conditions. These parameters often are

based on the installation environment of the wind power generation equipment – i.e., the wind power resources -- and the equipment are designed with a predetermined objective after undergoing a great deal of aerodynamics testing. For these reasons, when the wind power generation equipment leaves the factory, its design parameters cannot be randomly adjusted in accordance with the actual working conditions or, if they can, the range of adjustment is extremely narrow. Because the parameters of wind power resources cannot be fixed, the design parameters of wind power generation equipment cannot always be matched with the wind power resource conditions even through meticulous design. When the conditions are not matched, the power generation efficiency is extremely low. For example, manufacturers usually design small-size wind power generation equipment for a wind speed of greater than 11 m/s, but the average wind speed in actual operating environments of small-size wind power machinery can only reach 3~5 m/s. For this reason, the actual power output often can only reach one tenth of the rated power output.

In addition, the more advanced wind power generation equipment currently available in the world use the type of propeller rotor or axial flow rotor used in aerospace technology. Testing has shown that propeller rotors and axial flow type rotors operate optimally under conditions of high-speed airflow. In general, the diameter of an airplane propeller rotor does not exceed 3 meters, but the power output can reach 600 ~ 3,000 kilowatts. Although the diameter of a helicopter rotor is somewhat bigger, the operating speed of its blade tip position generally reaches over Mach 0.5. Therefore, use of these types of aerospace technology application propeller rotor structures in wind power generation areas with lower wind speeds (general operating wind speeds of only about 5~10 m/s) is far out of the aerodynamically appropriate range of usage for a propeller rotor. Also, it is very difficult, to lower the manufacturing costs. With its high manufacturing & usage costs and low wind power efficiency, its technological targets make it very difficult for wide distribution of wind power resources and for the products to reach a viable usage level. This type of wind power generation equipment, therefore, can only be used at a wind power generation site with relatively rich wind power resources. Essentially, the application of propeller rotor technology in the realm of wind power generation has been a misleading direction in its technological development. Not only is it disadvantageous to the utilization of wind power resources, but also it has prevented other technological advancement from establishing a large user base.

The earliest human use of wind power stems from popular windmills. People used windmills for irrigation and milling, basically turning wind power into mechanical energy,

such as the widely known Dutch windmills. In order to increase the wind power conversion efficiency of windmills, these locally used windmills needed to be designed and installed in accordance with the local wind conditions, and they needed to be individually adjusted so as to achieve the highest wind power / mechanical power conversion efficiency. Individual adjustment methods, however, were not suited to large-scale production of windmills, and the additional adjustment increased the manufacturing and usage costs of the windmills. Even more importantly, once a windmill is installed, its structure is fixed, and it is no longer adjustable. In keeping with the electrical energy demands of modern man, people began to use windmills to generate electricity. Because these popular windmills could not be randomly adjusted according to the wind conditions during operation, their conversion efficiency was similarly compromised. Current use of windmills to generate electricity, therefore, is not fully developed and widely adopted. .

Under general conditions, windmills or the propellers in wind power device inventions all increase the torque of the wind power rotors by increasing the diameter. When a wind power rotor with an excessively large diameter encounters strong winds, however, the propeller blades can be easily damaged. Materials such as high strength carbon fibre materials are usually used to manufacture the blades of current wind power generation devices, and the manufacturing costs are extremely high as a result.

Brief Description of Invention

The first object of this invention is to provide a framework composition windmill that makes a fundamental breakthrough in the limitations of current wind power generation technology and endows wind-driven rotors with artificial intelligence. It can automatically adjust match the speed between the wind-driven rotors and transducers with the changing wind speed, which ensures the best dynamic response whenever necessary. It can raise the effective wind power conversion efficiency in low wind speed areas, thereby increasing the wind power effective utilisation factor under low wind speed conditions and ensuring operation in all climates of wind power generation in low wind speed areas. These advantages will benefit the utilisation and popularisation of wind power generation technology.

The second object of this invention is to provide a framework composition windmill in place of the existing wind power generation equipment with complex and costly technologies. It provides easy installation and low maintenance, thereby greatly reducing the costs of wind power generation.

The third object of this invention is to provide a framework composition windmill using the traditional rotation framework structures of herdsman nationalities. It ensures the safe usage and operation of the windmill structure under different wind power conditions.

The objects of this invention are brought about as follows. The framework composition windmill is composed of a cylindrical tower with the wind power dynamic force components at its top end. It is specially characterised by the fact that the wind power dynamic force component includes a wind-driven rotor and STS energy exchange coupling elements. The STS energy exchange coupling element is comprised of two solid-state relative turning bodies that make up the dynamic energy transducing end. This includes an electromagnetic component and a magnetic component. The magnetic component is combined with the wind power rotor to form a moving assembly. A speed increasing gear component can be added inside. The electromagnetic component is installed on the support structure to form an electronic stationary module. Its electrical cable connects with the lower portion of the terminal box through the centre of the tower. The electromagnetic component and the magnetic component in the energy exchange coupling element of the STS dynamic energy exchange terminal are composed of two annular solid-state elements, and there is 0.5 ~ 2.5 mm between the inner ring and the outer ring. The electrical control terminal that carries out timely control of the STS energy exchange element is located in an appropriate location inside the windmill. The wind-driven rotors include at least two blades, and each of these blades is supported by a bow-shaped frame vertically connected at the blade ends of the bow-shaped frame and forming a tension structure. More than 3 taut cords are installed at the lower end of the cylindrical tower to act as supplementary support. The cross-section of the blades is made convex on the back and concave on the belly by a bone structure. Its outer edge has a longer streamline forming the back of the blade, and its inner edge has a shorter streamline forming the belly of the blade. The back of the convex portion of the cross-section of the blade has the same aerodynamic shape as a glider. The blades can be covered with sailcloth or fibreglass material.

The most important advances of this invention with regard to wind power generation equipment is that it makes use of STS technology (i.e., triode exchange reverser/transducer, see China Patent No. 97119117.4), which directly integrates the wind power dynamic component and the STS transducing component into one body. This creates integrated wind power energy equipment that is a single unit of set design. The essence of the invention is that, according to the distribution needs for wind power usage,

the aerodynamic conversion element and the STS component are directly combined to make a light framework structure and form a wind power transduction and electrical power transduction dual function electronic apparatus. The windmill rotors are uniquely designed with artificial intelligence, enabling them to ensure the most advantageous dynamic responses at any given time, especially under low wind speed conditions. It makes the speed match between the wind-driven rotor and the transducer, and maximizes the wind power conversion efficiency, thereby raising the effective utilisation rate of the wind power. It has been proven through extensive testing and experiments that with this invention the wind power effective utilisation rate under wind speed conditions of less than 10 mph is more than twice that of conventional wind-driven rotors. This invention ensures continuous and highly efficient operation of wind power generation equipment in low wind speed areas. This breakthrough in the limitations of current wind power generation technology has been made at fundamental level, which makes commercialisation of wind power generation technology possible. .

In addition, this invention uses wind-driven rotor blades based on the theories of aerodynamics. It uses a traditional style, light framework structure optimally designed through ternary fluxion value calculation and targeted at low usage of wind power resources. Random circumstances of major destruction in designing the blades into "tense bowstring" style bow-shaped framework structures. Because the mechanical structure of the blades is entirely different from the cantilever beam material mechanics of general wind-driven rotors, the power acceptance situation is simpler, the bow-shaped framework shape and the materials are flexible, and they can automatically flex under strong winds. In addition, they are not easily broken, and the blade length, therefore, has almost no limitation. This invention is safer to use than traditional windmills.

The aerodynamic design of this invention's wind-driven rotor is based upon similar aerodynamic principles for a glider. Because the airflow on the back of the blade is greater than on the belly of the blade when the wind-driven rotor is rotating, the force of lift acts on the belly of the blade according to Bernoulli's principle and, acting as a rotor, the rotor causes a tangential force to be obtained. Under appropriate matched conditions between motion speed and wind speed, this wind-driven rotor can obtain a much higher wind power utilisation rate than common propeller rotors, and it is well managed when fitted with this STS control system. This unique structure that helps to accelerate the blade rotation generally does not need to be fit with a gear accelerator. It minimizes loss of wind-driven power, and increases the conversion efficiency of wind power. For these reasons, this invention is better suited to working in changing climates and low wind

speed conditions than the current wind power generation equipment with propeller rotors and axial flow rotors.

Based on the two significant advancements described above, this invention has broken through the structural limitations of traditional wind power generation equipment and effectively resolved the problem of wind power generation in low wind speed areas. The large amount of test data shows that, in low wind speed areas, the power generation efficiency of this invention more than twice as high as current wind power generation equipment. With this invention, the conversion efficiency under 10 mph wind speed conditions can reach over 60%, while current propeller rotor wind power generation equipment can only maintain efficiency of 30% because of mismatch between actual and design wind speed.

This invention uses traditional types of light framework structures, replacing wind power generation equipment that has complex manufacturing processes and high manufacturing costs. It is easy to install, convenient to maintain and repair, and its manufacturing cost under equally low speed conditions is therefore 70% to 80% lower than wind power generation equipment of equal capacity. In addition, this type of tower structure using taut cords generally will not be destroyed by strong winds. Low cost manufacturing and usage can be realised, thereby making this invention more advantageous to the popularised use of wind power invention technology.

Another advantage of large-scale popularisation of this invention is that, when the windmills in this invention are widely distributed, they can form a green protective screen of benefit to environmental protection. If the windmill blade structure of this invention is used, therefore, the rotating wind-driven rotor causes a tangential force to be obtained because, according to Bernoulli's principle, the airflow over the back of the blade is greater than the belly, and the belly of the blade obtains lift. This tangential force enables the wind-driven rotor to form wind eddies around the wind-driven rotor. These wind eddies can, on the one hand, accelerate the windmill rotation and further increase the energy conversion efficiency of this invention. On the other hand, they can absorb a large amount of wind energy, so at the same time as a line of windmills in this invention is transforming wind energy into kinetic energy, it has absorbed a large amount of wind power energy and greatly weakened the wind power crossing over the windmill line. The windmill line, therefore, forms a green protective screen by checking the wind and fixing the shifting sand. Moreover, because the wind speed is controlled using artificial intelligence, it can utilise wind speed in the same way as a grain separation windmill – using the gravity

precipitation method to separate the sand and the soil and deposit it on the ground, thereby achieving the effect of desertification prevention

Description of Diagrams

Diagram 1 Schematic Diagram of the Structure of this Invention

Diagram 1A Power Acceptance Analysis of the Blades in this Invention

Diagram 2 Schematic Diagram of the Structure of the Top of the Tower in this Invention

Diagram 3 Schematic Diagram of the Structure of the Top of the Tower in this Invention in the 2nd Practical Example

Methods for Implementation of this Invention:

Practical Example 1

As shown in Diagram 1, this invention includes cylindrical tower (4), and the wind-driven rotor (2) components are installed at the top end of tower (4). The wind-driven rotor (2) is composed of at least two blades (21) and an STS energy exchange coupling element (3).

As shown in Diagram 2, the STS energy exchange coupling element (3) that is composed of two solid-state relative turning bodies makes up the power transduction end of this invention. One of these relative turning bodies is an electromagnetic component, and the other is a magnetic component. The electromagnetic component includes a magneto magnetic drum (6). With the wind-driven rotor, one of these makes up the mechanical assembly (7) and the other is installed on the support structure to become the electronic stationary module (8). In this invention, the electronic stationary module (8) composed of the electromagnetic component, and the mechanical assembly (7) composed of the magnetic component, are both part of the STS energy exchange end's energy exchange coupling element (3) and make up two annular solid-state components. There should be a space between the inner ring and the outer ring of 0.5 ~ 2.5 mm. The electronic control end (13) that carries out timely controls of the STS energy exchange coupling element is located in an appropriate location inside the top end of the windmill equipment. As shown in Diagram 2, the electronic stationary module (8) is fixed inside the housing body (9) at the top of the equipment. The fixed cover plate (10) is located at the bottom end of the housing body (9). The output terminal of the mechanical assembly (7) is designed as the drive portion (25) connected to the wind-driven rotor (2), and the wind-driven rotor (2) can

drive the rotation of the drive portion (25). The post (12) passes through the opening in the centre of the drive portion (25) and connects with the top end of the tower (4).

The STS (triode exchange reverser/transducer) used in this invention was disclosed in invention patent application No. 97119117.4 in 1997. It acts as a new type of energy resource usage equipment that can be used to change the power structure of various types of machinery and add artificial intelligence. This equipment has already been designed into broad-spectrum seriated core components that can extremely conveniently be made up into various types of specialised equipment and be further made into advanced electromechanical types of equipment. The working principle of this invention used by STS is that the mechanical assembly (7) of its power conversion end is connected on the wind-driven rotor (2) of the windmill through mechanical adaptation. Under the effect of the wind power, the mechanical assembly (7) follows the wind-driven rotor (2) main drive rotation movement, and electrodynamic force is produced by the coil winding induction in the electronic stationary module. This electrodynamic force is controlled by the two-way reversible changer resulting in the formation of power flow sent to the power supply network in keeping with standard power supply formats. This process can be completed through generation of appropriate command adjustments from the STS electronic control end (13) to control the rotation speed of the mechanical assembly (7). This electronic control end (13) is regulated by a software system on the basis of different information on wind speed changes and generates timely adjustments and control commands to the transduction end. This results in the transduction end very quickly achieving the best response, thereby endowing the wind-driven rotor (2) with artificial intelligence.

Significant advancements have been made in this invention for the windmill's wind-driven rotor (2) in current technology. The primary advance has been made with the blades (21) of the windmill rotor. As shown in Diagram 1A, the blades (21) of the wind-driven rotor (2) in this invention are based on aerodynamic principles. Using the optimised design of ternary fluxion value computers, either sailcloth or fibreglass acting as the surface material of the blade (21) surface (212). Its cross section is moulded out of a bone structure (211) to form an aerodynamic surface that is the same as that of a glider. The blade (21) that is formed by this aerodynamic surface is vertically supported on the flexible bow-shaped framework (1). The outer edge of the blade (21) is the back (213) of the blade surface and has a relatively long line of flow. The inside edge is the belly (214) of the blade surface and has a relatively short line of flow. The front edge of the blade (21) is at the leading edge of the direction of movement.

The wind power and dynamic exchange principle of this invention is that, with regard to the wind-driven rotors (2) on opposing sides of the blades (21), the lateral force after being balanced is dominant on the back (213) of the blade (21) because the lateral force on the belly (214) of the blade (21) in the wind is greater than the lateral force on the back (213) in the wind. In addition, because placement angle β of the blade (21) is less than the tangential path of rotation, a tangential force along the direction of rotation is obtained.

While the wind-driven rotor (2) is rotating, the blade belly (214) obtains lift because the air flow over the blade back (213) is higher than the air flow over the blade belly (214) in accordance with Bernoulli's Principle. This lift acts to cause the rotor to obtain a tangential force along the direction of movement. In appropriately matched conditions of motion speed and wind speed, the wind-driven rotor (2) can obtain a much higher wind power utilisation rate than with a common propeller rotor, but it cannot itself control the running status. Its running process must be managed by the control system. Because the blades (21) need to be able to bear tension, it is difficult for general wind power generation equipment to operate under the increasingly complex and exacting work conditions. This invention can be manufactured so that it is extremely light and portable. Fibreglass can be used for the wing surface (212) material, and expensive carbon fibre materials no longer need to be used.

The aerodynamics of this invention are similar to those of the wings of a glider, but its support structure is not evenly placed on the single point supported cantilever frames of the two sides of the airframe; rather, it has used a bow-shaped framework (1) to support the vertical tension suspension structure. For this reason, the upward airflow used by a glider acts as the lift for gliding flight while this invention uses level wind force as the dynamic force for the wind power equipment. It is exactly the same aerodynamic wing shape, and the glider derives lift and gliding tractive force from the airfoil while this invention derives driving rotor rotation tangential force from the blade (21).

The back (213) of the blade in this invention is relatively long, and the belly (214) of the blade is relatively short. When the wind-driven rotor (2) rotates the airflow past the blades (21), the pressure on the belly (214) of the blade is higher than on the back (213) of the blade because, according to Bernoulli's Principle, the flow speed of the air flowing past the back (213) of the blade is higher than the belly (214) of the blade. Only if the placement angle β of the blade (21) is less than the tangential path of the wind-driven rotor's (2) outer edge can the wind-driven rotor (2) obtain driving force in the direction of rotation. Because

a structure that is specifically designed for use with low speed wind power is utilised, the structure in this invention is even better suited to distribution type generation under low wind speed conditions.

The abovementioned wind-driven rotor structure of the bow-shaped framework (1) in this invention leaves a fixed space at the bottom end of the tower (4) so that it does not have any other supplementary supports. The three to four taut steel cables shown in Diagram 1 are fixed, and because the tower structure is not under an inclination load, it can be installed on a simple concrete foundation (5). The cost of the tower in this invention is, therefore, considerably less than the towers in current power generation equipment.

The electrical cable that is a component of the electronic collector in this invention connects with the lower portion of the terminal box through the centre of the tower (4) and outputs the current to the electric network.

Practical Example 2

The basic structure of Practical Example 2 of this invention is similar to Practical Example 1. The difference is that a speed increasing gear component can be included inside the mechanical assembly (7) to handle the speed matching between the wind-driven rotor (2) and the transducer.

As shown in Diagram 3, the electronic stationary module (8) made up of the electromagnetic component in the energy exchange coupling element (3) of the STS dynamic energy transducing end and the mechanical assembly (7) made up of the magnetic component form two annular solid-state components. The space between the inner ring and the outer ring is between 0.5 ~ 2.5mm. The electronic control end (13) that carries out timely controls of the STS "energy exchange coupling element" is located in an appropriate location inside the top end of the windmill equipment. The electronic stationary module (8) is fixed inside the housing body (9) at the top of the equipment. The fixed cover plate (10) is located at the bottom end of the housing body (9). The output terminal of the mechanical assembly (7) has a gear wheel (35), and it is connected by this gear wheel (35) to a planet gear structure inside the housing body (9) at the bottom end. The planet gear (33) in this planet gear structure meshes with the gear wheel (35), and the planet gear (33) drives the rotation of the lower housing (31) through the gear ring (32) with which it is meshing. This planet gear mechanism is supported inside the lower housing body (31) by the support structure. There is a circular flange at the bottom end of

rotatable top of the lower housing body (31) that acts to connect the driving portion (14) to the wind-driven rotor (2), and the rotation of this driving portion (14) is driven by the wind-driven rotor (2). The post (12) is supported at the bottom end of the lower housing body (31) through the support structure (15) described above, and it is fixed at the top end of the tower (4).

The working principle for this practical example is the same as that of Practical Example 1 and will not be discussed further here. The additional mechanical speed increasing mechanism in this invention can also use other traditional mechanical speed change devices.

In addition, because the STS device in this invention is a serialised technological means for physical energy conversion, it has obtained patent rights in China and been designed into seriated foundation products for supplying industrial usage. On the basis of the STS assembly, this invention combines the aerodynamic wind-driven force component directly with the STS device exchange component into one entity according to the power usage needs of pastoral regions. In this way, an electronic apparatus with the dual function of wind power exchange and electromechanical exchange has been created and thereby enabled this invention to bring about structural simplification by using the high technology integrated means of areas with concentrated wind power usage. In pastoral areas, its use simplifies solution to the problem of combining fixed machinery components and standard materials with STS into a rational structure that is convenient to maintain and repair. This will further help to popularise implementation of this invention.

Claims :

1. A framework composition windmill composed of a cylindrical tower and a wind power dynamic component that is at the top end of the tower, said wind power dynamic component including a wind-driven rotor and an STS "energy exchange coupling element" having a dynamic energy transducing end of the STS "energy exchange coupling element" made up of two solid-state relative turning bodies, of which one is an electromagnetic component and the other is a magnetic component, one of said solid-state relative turning bodies being combined with the wind-driven rotor into the mechanical assembly module, and the other of said solid-state relative turning bodies being installed on the support structure as the electronic stationary module, said wind-driven rotor including at least two blades installed on and supported by a flexible bow-shaped framework, said blades being vertically connected at the bowstring end of the bow-shaped framework.

2. A framework composition windmill according to Claim 1, wherein the electromagnetic component and the magnetic component in the transduction element of the STS dynamic energy transducing end are composed of two annular solid-state components, the space between the inner ring and the outer ring being between 0.5 ~ 2.5mm, and wherein an electrical control terminal that carries out timely control of the STS "energy exchange element" is located in an appropriate location inside the windmill.

3. A framework composition windmill according to Claim 1, wherein the power output end of the electronic collector component is connected with the terminal box at the lower portion through the centre of the tower by an electrical cable.

4. A framework composition windmill according to Claim 1 or Claim 2, wherein a mechanical speed increasing gear component is added inside the mechanical assembly that is made up in combination with the wind-driven rotor.

5. A framework composition windmill according to Claim 1, wherein the lower end of the cylindrical tower has more than 2 taut cords to act as supplementary support.

6. A framework composition windmill according to Claim 1, wherein the cross-section of the blade is made convex on the back and concave on the belly by a bone structure, the outer edge of the blade having a longer streamline forming the back of the blade, and its inner edge having a shorter streamline forming the belly of the blade.

7. A framework composition windmill according to Claims 1 or 6, wherein the blade above is covered with either sailcloth or fibreglass material.

8. A framework composition windmill according to Claim 6, wherein the blade is placed vertically at the bowstring end of the bow-shaped framework to form a tension suspension structure.

9. A framework composition windmill according to Claim 6, wherein the convex back of the cross-section of the blade has the same aerodynamic shape as that of a glider.

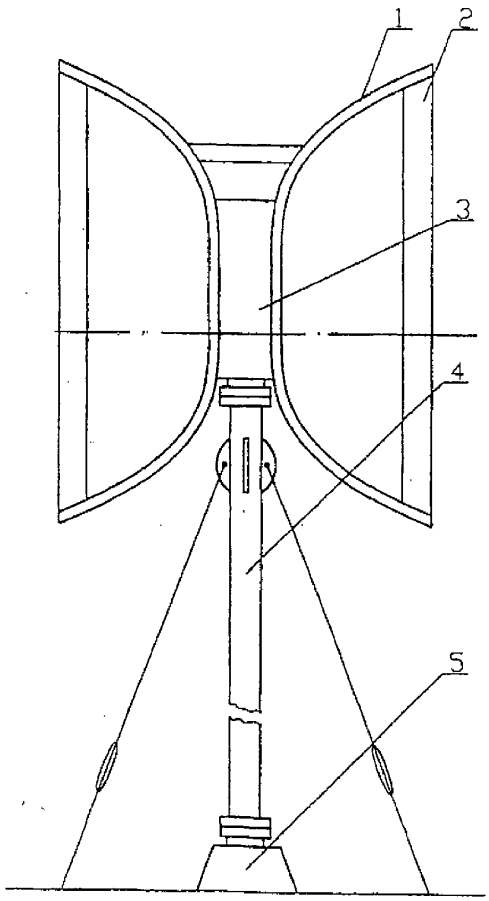


Fig.1

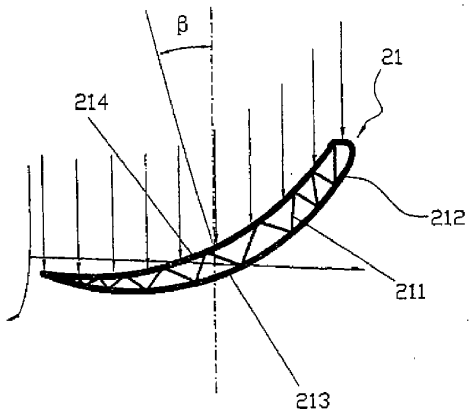


Fig.1A

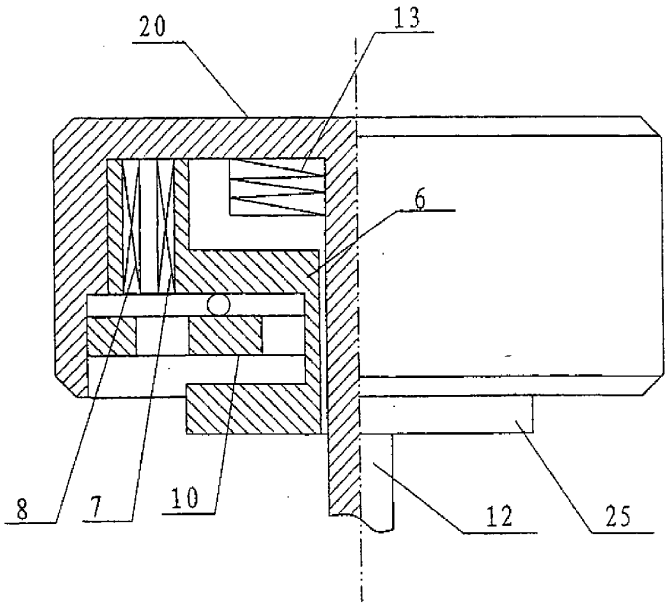


Fig.2

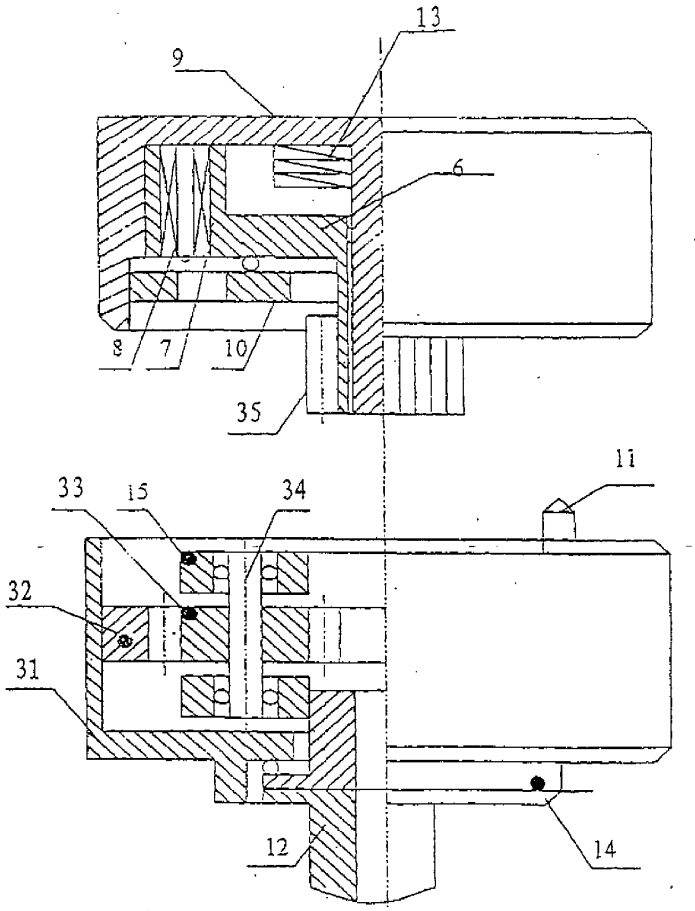


Fig.3