

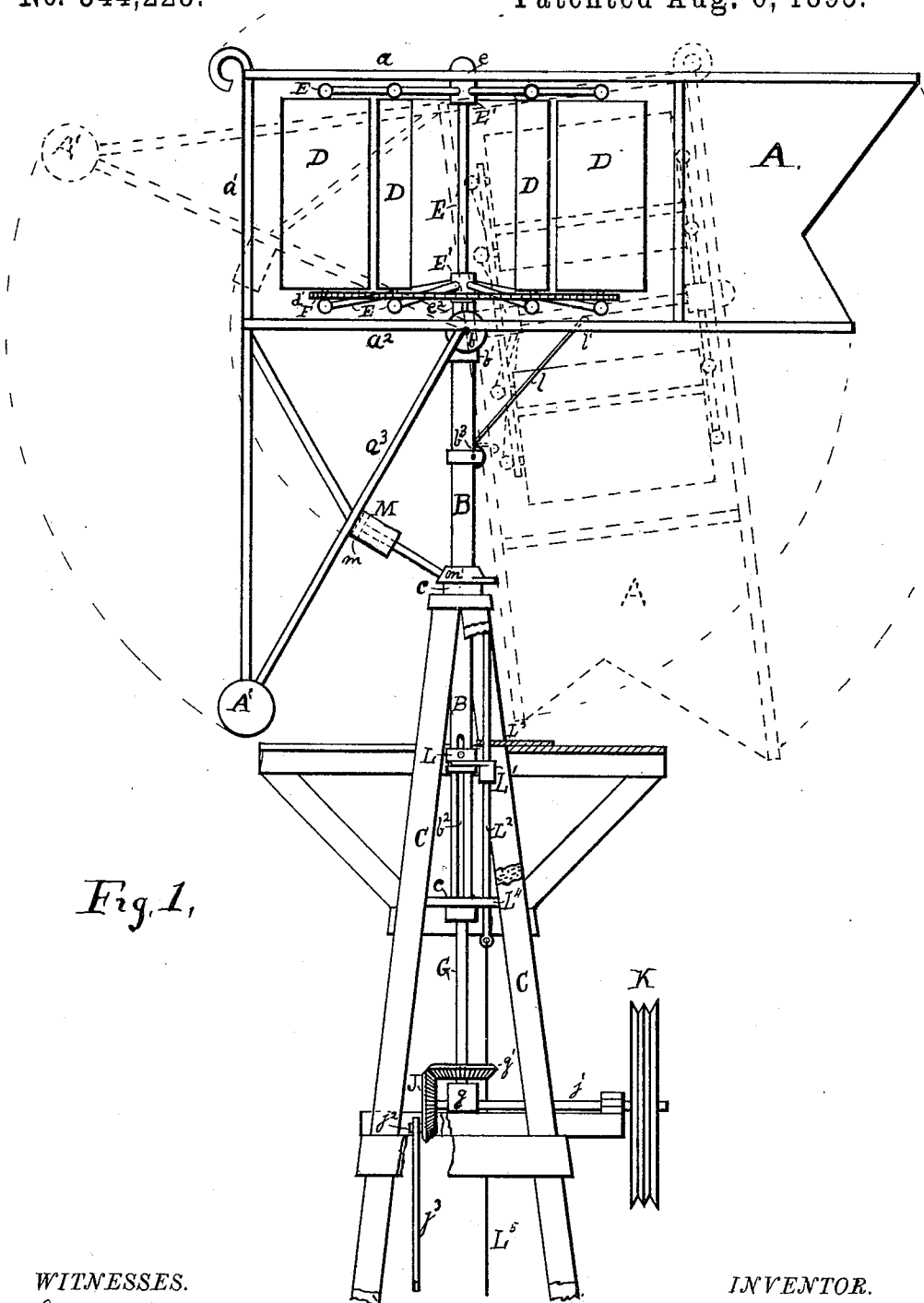
(No Model.)

3 Sheets—Sheet 1.

H. S. HOPPER.
WINDMILL.

No. 544,228.

Patented Aug. 6, 1895.



WITNESSES.

G. N. Rda.

Robert Everett.

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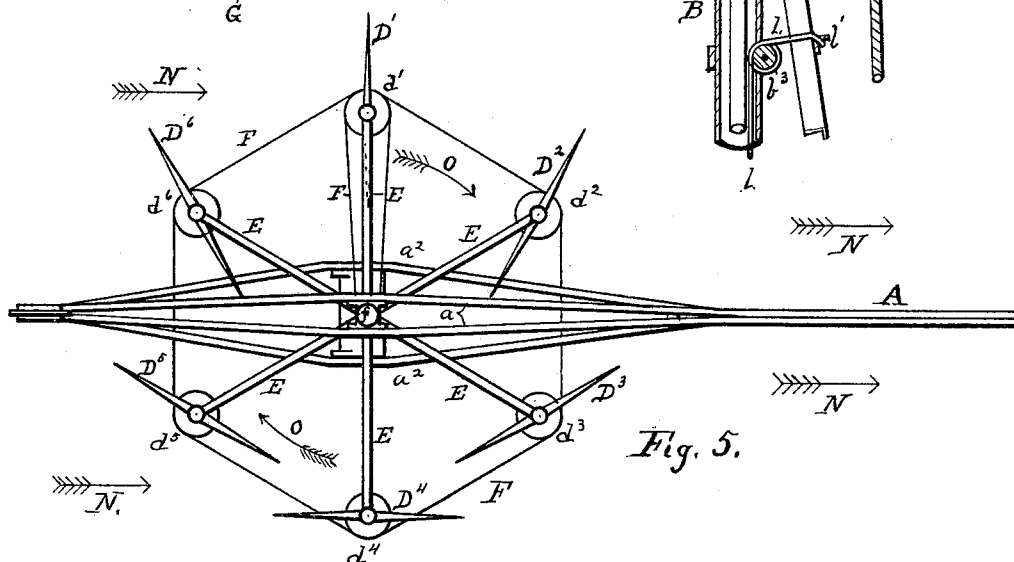
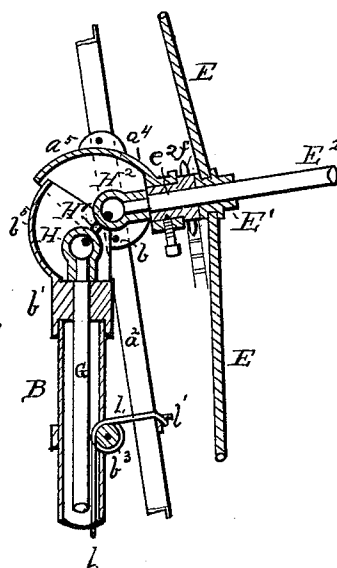
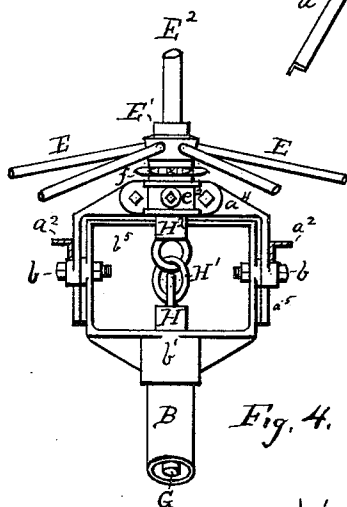
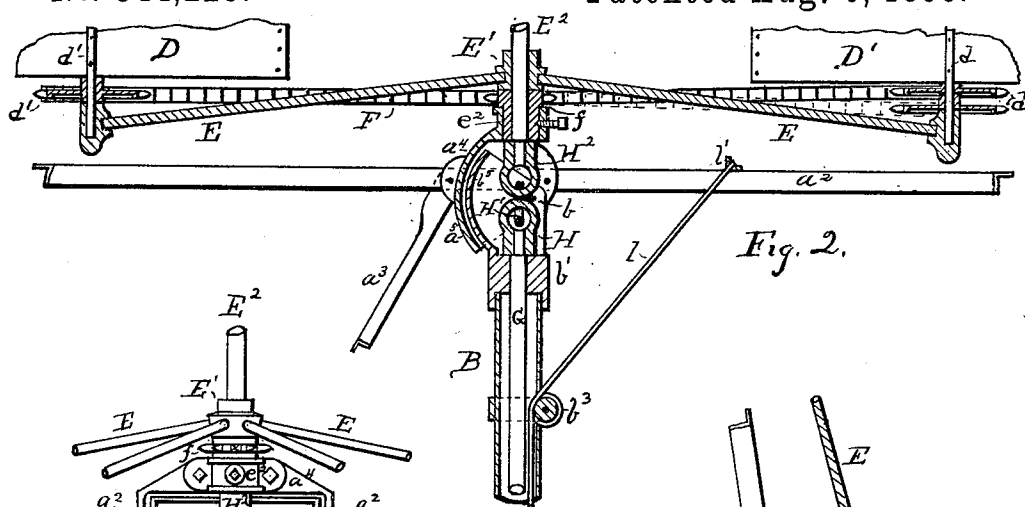
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H. S. HOPPER.
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No. 544,228.

Patented Aug. 6, 1895.



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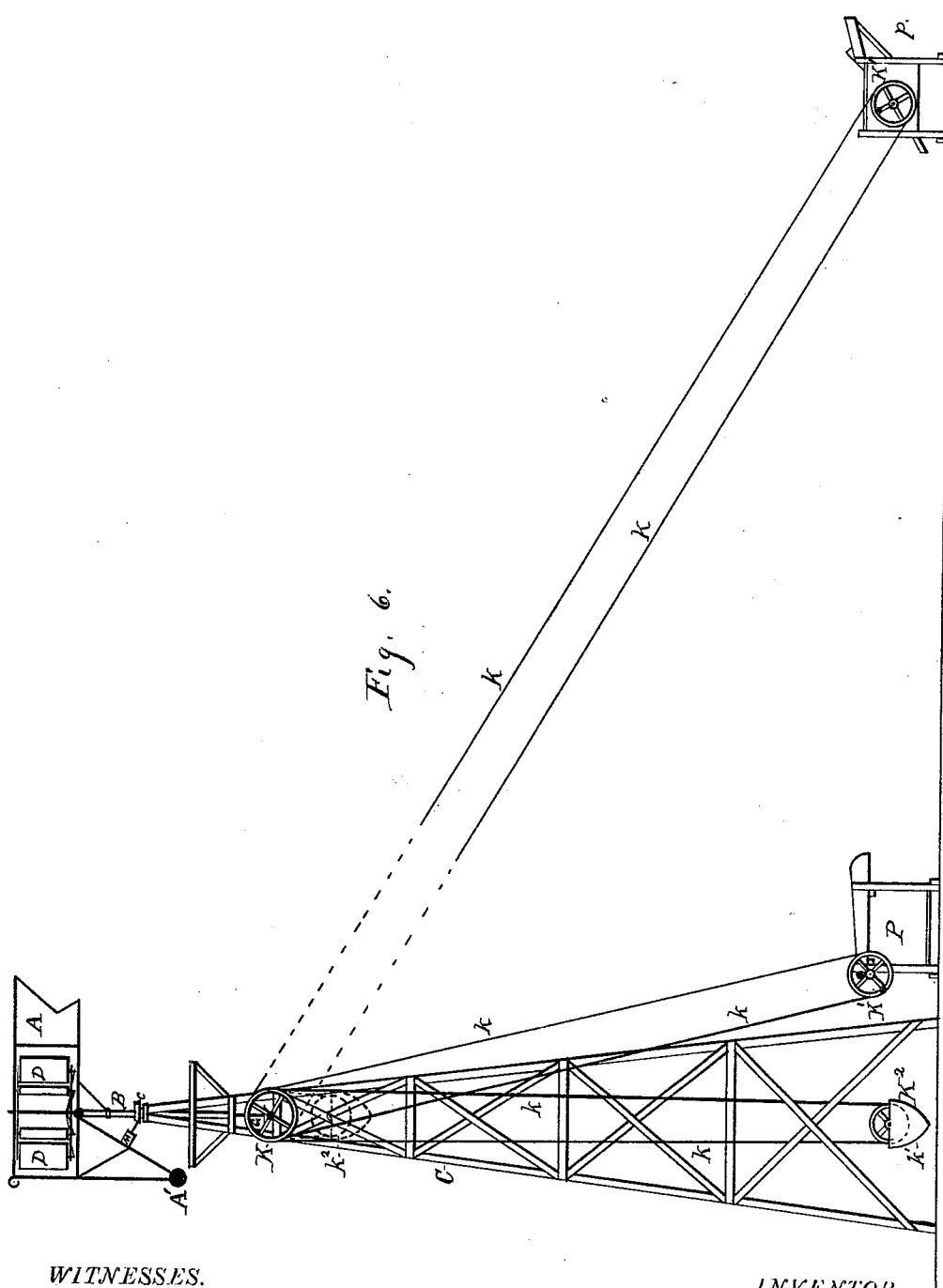
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3 Sheets—Sheet 3.

H. S. HOPPER.
WINDMILL.

No. 544,228.

Patented Aug. 6, 1895.



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HENRY S. HOPPER, OF DETROIT, MICHIGAN.

WINDMILL.

SPECIFICATION forming part of Letters Patent No. 544,228, dated August 6, 1895.

Application filed June 16, 1894. Serial No. 514,792. (No model.)

To all whom it may concern:

Be it known that I, HENRY S. HOPPER, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented new and useful Improvements in Windmills, of which the following is a specification.

The object of my invention is to provide a windmill adapted to drive light farm or other machinery without veering around out of the wind when crowded with work, but which will continue to give its full power regardless of load even in a gale; also to provide a horizontal windmill, which will automatically vary the sail area exposed to the wind in proportion to the strength of the wind; and further to provide a reliable, convenient, and economical means for communicating power from the windmill to various machines located at different distances therefrom.

In the drawings, Figure 1 is a side elevation with upper portion of tower, showing the windmill in working position by the full lines. The dotted lines show its position when out of the wind. Fig. 2 is a vertical fractional section, on enlarged scale, through center of shaft and sails and in line with the vane, showing principal parts in detail and in working position. Fig. 3 is a similar enlarged section showing position of principal parts when thrown out of the wind. Fig. 4 is an elevation of principal parts at right angles to position shown in Figs. 2 and 3. Fig. 5 is a plan view of entire windmill. Fig. 6 is a side elevation of windmill and tower, showing mode of transmitting motion to different machines.

The principal features of my invention are as follows:

The vane A is carried on the rectangular frame a a' a^2 , which is connected at b by horizontal pivots to the top of a hollow vertical mast B, which is journaled upon the top of the tower C at c c' , so as to be turned by the vane A as the direction of the wind changes. The counterbalance-weight A' is attached to a bracket suspended from the front or windward end of the vane-frame a' a^3 , and is adapted to hold the vane-frame in a horizontal position.

Each of the sails D has passed through its center a vertical shaft d , which is journaled in the extremities of the spider-arms E E at-

tached to the hubs E' E' on the main vertical shaft E². The shaft E² is journaled upon the vane-frame a a^2 at e and e^2 . Attached to the sails D are sprocket-wheels d' , connected together by the chain F, which also runs over the sprocket-wheel f , which is rigidly attached to the vane-frame a^2 at e^2 , where it forms the lower bearing for the main shaft E³, which it encircles.

G is a vertical shaft rotating in the center of the hollow mast B, and journaled upon it at b' . Its lower end is journaled upon the tower at g . It is connected to the main shaft E² by the links H H' H², which form a universal coupling, which permits the main shaft E² to be inclined at an angle with the vertical tower-shaft G. In the universal coupling the link H is rigidly attached to the end of the tower-shaft G and the link H² to the end of the main shaft E² in the same manner, while the ring H' loosely engages both the links H and H².

The tower-shaft G is provided with a bevel gear-wheel g' , which meshes with another bevel gear-wheel J on the end of the horizontal jack-shaft j . The bevel gear J is provided with a crank-pin j^2 , to which the pump-rod j^3 is connected. The horizontal jack-shaft j extends a considerable distance beyond the side of the tower and carries at its extremity a grooved pulley K. K' is a similar grooved pulley attached to the machine to be driven, and K² is a grooved tightener-pulley with counterweight k' attached. It hangs upon one loop of the rope or cable k , which runs in the grooves of the pulleys K K'.

The lower portion of the hollow mast B is slotted, as at b^2 . It is encircled at this point by the sliding collar L, which is connected by means of the cord, chain, or cable l , which passes through the slot b^2 inside the hollow mast B, and over the sheave b^3 to the vane-frame a^2 , to which it is attached at l' . The shifter-fork L' engages the groove in the sliding collar L, and is attached to a vertical rod L², which slides in guides I³ L⁴ upon the tower. L⁵ is a rod, rope, or other means for extending the rod L², so as to operate it from the ground to throw the windmill out of the wind.

The letter M indicates a dash-pot attached to the weight-braces a^3 of the vane-frame.

The plunger m fits loosely in the dash-pot, as indicated by the dotted lines in Fig. 1, and is rigidly attached to the mast B at m' . To the vane-frame $a^2 a^3$ is attached a fulcrum-piece a^4 , which is connected to the mast-head b' by the pivot-bolts $b b$. Both the fulcrum-piece a^4 and the mast-head b' are provided with weather-guards $a^5 b^5$.

One of the sails D is provided with two sprocket-wheels $d' d''$, and all the others have but one. I prefer to pass one continuous chain F around all the sprocket-wheels. That is, commencing with the chain F, about the small sprocket-wheel f , connect it with and around the upper sprocket-wheel d' , thence around the outside of the said sprockets d^2, d^3, d^4, d^5 , and d^6 in succession to and around the lower sail-sprocket d' , where it is connected to the other end of the chain F from the small sprocket f . However, two separate chains may be used, one of them connecting the small sprocket f to the upper sail-sprocket d' , while the other passes around and engages the sail-sprockets $d^2 d^3 d^4 d^5 d^6$ and the lower sail-sprocket d' only.

The chain F holds the sails D', D^2, D^3, D^4, D^5 , and D^6 in the positions shown in Fig. 5, that of D' being in line with the spider arm or spoke E and at right angles to the vane-frame $a a^2$ and also to the direction of the wind, as shown by the arrows N. It also holds the sail D^2 at an angle of thirty degrees to the spider-arm E and sixty degrees to the vane-frame, D^3 at an angle of sixty degrees to the spider-arm E and thirty degrees to the vane-frame, D^4 at right angles to the spider-arm and parallel with the vane-frame and the direction of the wind, D^5 at an angle of sixty degrees to the spider-arm and thirty degrees to vane-frame, and D^6 thirty degrees to spider-arm and sixty degrees to vane-frame.

It is evident that as the sails $D^6, D',$ and D^2 stand at greater angles to the wind than the sails $D^3, D^4,$ and D^5 the wind-wheel will revolve in the direction indicated by the arrows O, and as the small sprocket f is one-half the diameter of the sprockets d' , and as it is held stationary by the vane A, the chain F will draw the sails into new positions, D' taking the position of D^2 when it has made one-sixth of a revolution and that of D^3 at one-third of a revolution, and so on around, making one half a revolution about its own axis d while it is making a complete revolution about the main shaft E^2 , returning to its original position D' , with its opposite side to the wind. In other words, the sails take exactly the same positions that the sails of a vessel would take in sailing around a circle.

The weight A' is heavy enough to hold the vane-frame $a a^2$ horizontal and the shaft E^2 and sails D vertical in moderate to stiff winds. However, as the force of the wind increases and the pressure on the sails becomes great enough to overcome the resistance of the weight A' the forward or windward end of the vane-frame $a a^2$ rises and the vane A de-

scends, thereby inclining the main shaft E^2 and the sails D from the vertical, so as to spill the surplus wind over the top of the sails. As the weight A' is located at some distance below the fulcrum b' of the vane-frame, it is evident that its resisting effect increases as the wind-wheel is inclined farther from a vertical position by the pressure of the wind and, consequently, that the effective sail area will be adjusted automatically by the weight A' to the pressure of the wind, even when said wind is very unsteady or gusty.

The dash-pot M forms a cushioned stop, against which the weight A' holds the mill while at work and obviates the jar that would otherwise be destructive when the windmill rights up after a heavy gust of wind has passed by. In case of a storm or extra heavy wind, the vane-frame is swung down by the wind against the stop m' on the mast B, opposite to the dash-pot M, in which position the sails D present only their bottom edges to the wind, thus reducing the resistance to the wind to a minimum. When it is not desired to run the windmill it may be drawn down to this position from the ground by the rod L^2 , which is then secured to a stop (not shown) on one of the posts of the tower.

It is evident that this windmill will not stop work until the force of the wind becomes destructive, as the universal coupling $H H' H^2$ will transmit the power from the wind-wheel shaft to the tower-shaft at any inclination of the main shaft E^2 until the sails take the position shown by the dotted lines in Fig. 1, when they present only their lower edges to the wind, and consequently produce no power.

By placing the jack-shaft j as near the top of the tower as practicable the length of the tower-shaft G, as well as its weight, and consequently the friction upon its bearings, is reduced to a minimum. This also raises the grooved drive-pulley K far enough above the ground to give considerable range of motion to the weighted tightener-pulley K^2 , which in turn allows the power to be transmitted to the pulley K' , located on various machines, which may be directly under the windmill, or at a considerable distance therefrom, as shown in Fig. 6, in which, when the rope k is connected to a machine P, located close to the tower, the position of the tightener-sheave K^2 is shown by the full lines to be near the ground at K^2 , while when the rope is connected to drive the machine p , located at the greatest distance possible from the tower, its position is shown by the dotted lines k^2 to be close to the grooved driving-pulley K, near the top of the tower. It is obvious that this arrangement would permit the application of power to machines placed at points between those shown in Fig. 6, as well as to the machines placed on the opposite side of the tower or at different elevations.

The bevel gear J is provided with a crank-pin j^2 , to which the pump-rod j^3 may be con-

nected when the pump is located beneath the windmill. However, it is not necessary to locate the mill over the well and pump, as is usual, as power may be transmitted to a pump located at a considerable distance from the windmill by means of the endless rope $\frac{1}{2}$. This arrangement is particularly advantageous where it is desired to pump water from a lake or stream, in which case the windmill may be located high up on the bluff or embankment, where a steady wind-pressure is available, and the pump may be placed at the water's edge. By this arrangement the windmill is of incalculable value for irrigation purposes, for many of our Western rivers, located in sections where irrigation is necessary, are apparently dry when water is most needed, though quite a quantity of water may be flowing through the coarse gravel in the bed of the stream out of sight, and by placing a pump over said running water and in the bed of the stream sufficient water may be raised to make much now worthless land productive. However, it would not be practicable to place a windmill in the bed of the stream, for the reason that great damage would be done to it during high water, and also on account of the expense necessary to raise it high enough to secure an effective wind-pressure; but by placing the windmill and tower upon the bank exposed to the wind and above high water and transmitting motion therefrom to a pump in the bed of the stream by means of the rope $\frac{1}{2}$ and grooved pulleys a constant supply of water may be had when most needed, for the position of the pump in the stream may be changed as necessary to accommodate it to the stage of the water.

What I claim as new is—

1. In a wind motor the combination of a vane connected by horizontal pivots to a hollow vertical mast adapted to turn with the vane, and a wind-wheel rotating a vertical shaft journaled upon the vane, substantially as described.

2. In a wind motor the combination of a vane connected by horizontal pivots to a hollow vertical mast adapted to turn with said vane, a wind-wheel rotating a shaft journaled upon the vane, a vertical power shaft rotating within the hollow mast, and a universal coupling connecting the wind-wheel shaft with the power shaft, substantially as described.

3. In a wind motor the combination of a vane connected by horizontal pivots to a hollow vertical mast adapted to turn with the vane, a wind-wheel rotating a shaft journaled upon said vane, a counter-balance weight

adapted to hold the wind-wheel shaft vertical in ordinary winds, and a universal coupling communicating motion to a vertical power shaft rotating within the hollow mast, substantially as described.

4. In a wind motor the combination of a vane pivotally connected with a hollow vertical mast adapted to be turned thereby, a wind-wheel rotating a shaft journaled upon said vane, a weight suspended from the windward end of the vane, a chain or cable attached to the leeward end of the vane and extending through the hollow mast, and a slot in the lower portion thereof to a sliding collar, a shifter fork engaging a groove in the sliding collar, and means for drawing it and the sliding collar downward to incline the wind-wheel and shaft from the vertical, substantially as and for the purpose described.

5. In a wind motor the combination of a vane pivotally connected to a hollow vertical mast adapted to be turned thereby, a wind-wheel rotating a shaft journaled upon the vane, a ring or link rigidly attached to one end thereof, a vertical power shaft rotating within the hollow mast, a ring or link rigidly attached to the upper end thereof, and a loose ring engaging the rigid rings upon the said shafts, substantially as and for the purpose described.

6. In a wind motor the combination of a vane connected by horizontal pivots to a vertical mast adapted to be turned thereby, a wind-wheel rotating a vertical shaft journaled upon the vane, a weight attached to a bracket suspended from the windward end of the vane, a dash-pot attached to said bracket, and a plunger attached to the vertical mast adapted to fit into the dash-pot and form a cushioned stop against which the vane is held in ordinary winds, substantially as described.

7. In a wind motor the combination of a vane connected by horizontal pivots to a vertical mast adapted to be turned thereby, a counter-balance weight attached to the windward end of the vane, a shaft journaled upon said vane, having wheels attached thereto, and sails located between said wheels and pivotally attached to the periphery thereof, substantially as described.

In testimony whereof I have hereunto set my hand and affixed my seal in presence of two subscribing witnesses.

HENRY S. HOPPER. [L. s.]

Witnesses:

JOHN H. POWELL,
CHARLES M. JOHNSON.