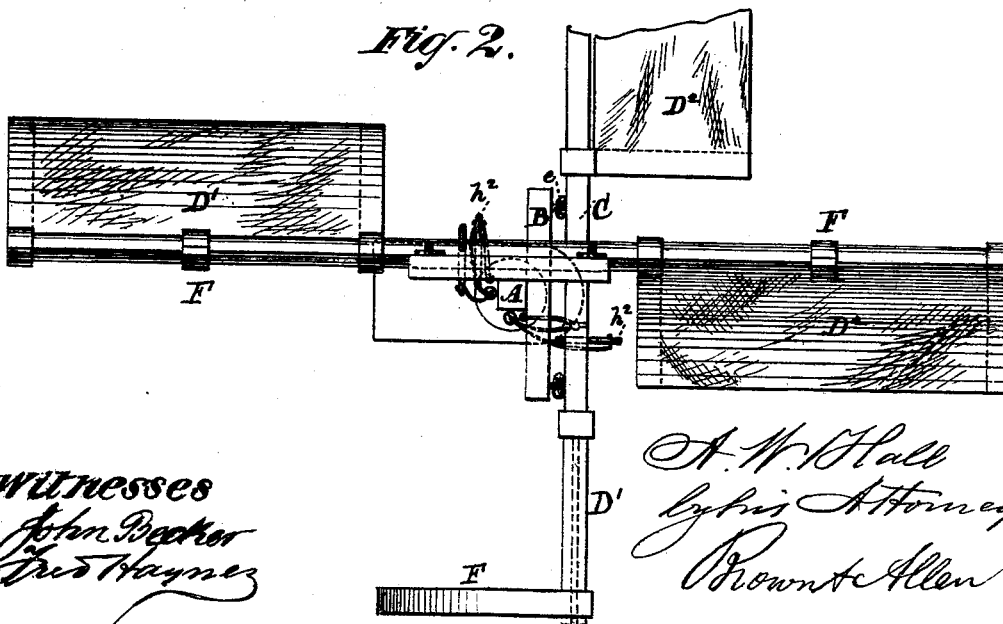
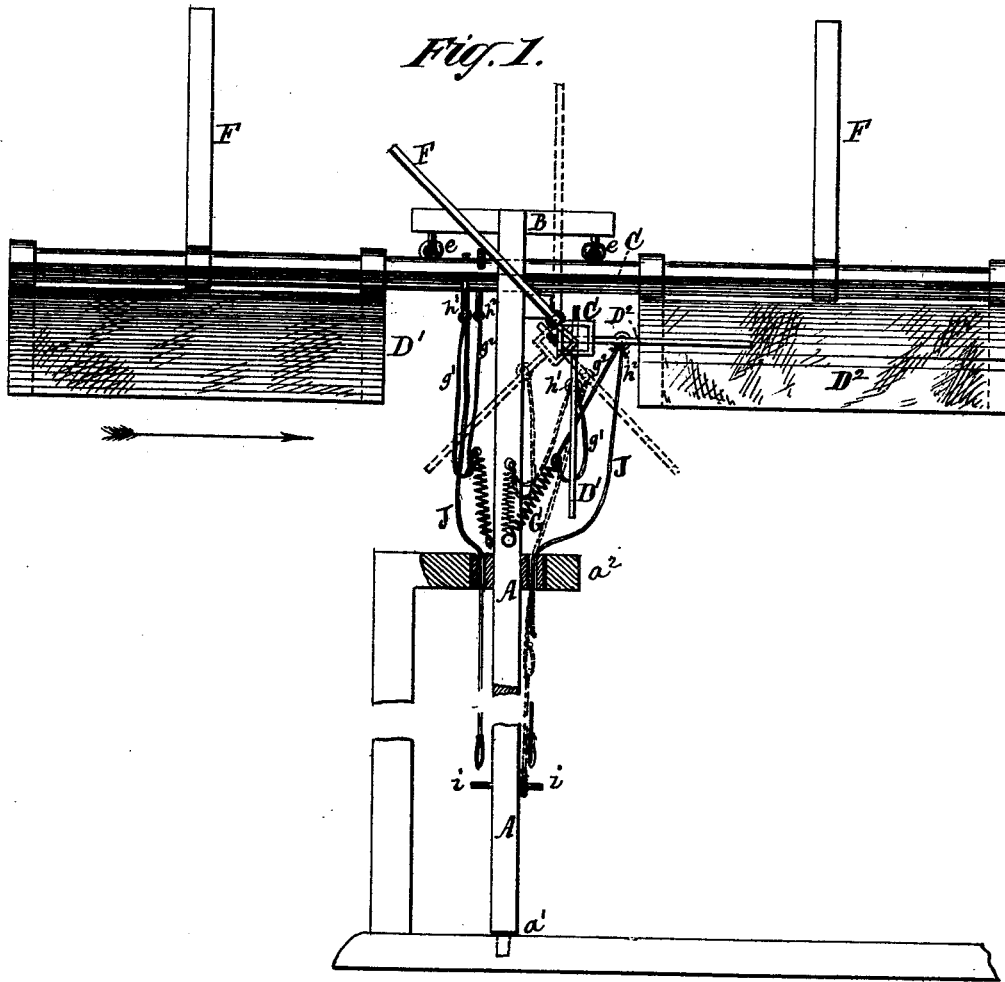


A. W. HALL.  
WIND-MILL.

No. 182,922.

Patented Oct. 3, 1876.



Witnesses  
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# UNITED STATES PATENT OFFICE.

ALEXANDER W. HALL, OF CINCINNATI, OHIO.

## IMPROVEMENT IN WINDMILLS.

Specification forming part of Letters Patent No. **182,922**, dated October 3, 1876; application filed March 17, 1876.

*To all whom it may concern:*

Be it known that I, ALEXANDER W. HALL, of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain Improvements in Windmills; and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention relates to certain improvements in vertical windmills, for the purpose of enabling the sails to automatically assume such positions as to receive the force of the wind during a portion of their travel, and to pass freely against the wind during the remaining portion, and also to regulate their positions in order to prevent the attaining of too high a speed.

The invention consists in a novel construction and arrangement of the sails and their carrying-arms and counter-balance bars, whereby the sails are so nicely adjusted as to insure their assuming the proper positions when traveling either with or against the wind, or when at rest, and whereby simplicity and cheapness are obtained.

The invention consists, further, in a novel arrangement and combination, with the sails and carrying-arms, of devices for regulating the positions of the sails, whereby the sail moving against the wind is enabled to counteract the effect of any increase or irregularity in the force of the wind upon the sail moving with the wind.

The invention consists, further, in a novel arrangement and combination, with the sail-carrying arms, of devices for stopping the mill by holding the sails in fixed positions.

In carrying out my invention I provide each carrying-arm with two sails, which are rigidly attached to the opposite ends of the arm at right angles to each other, so that when one sail is in a vertical position the opposite sail is in a horizontal position; and the carrying-arm is loosely arranged in or suspended from a cross head or bar or other bearings on the shaft or spindle, so as to allow it to partake of a reciprocating rotary motion when the sails oscillate from one position to another.

In order to hold the sails in the proper positions when operated upon by a wind of ordinary force, and also to provide for regulating the positions of the sails and the speed of rotation under extraordinary force or irregularity of the wind, I employ, in connection

with each pair of sails and carrying-arms, a spring, one end of which is fixed and the other end is connected with the sail or arm, so as to enable the vertical sail to yield to any extraordinary force and oscillate beyond a vertical line, and cause the opposite sail to rise above a horizontal line, so as to receive a portion of the force of the wind, and thus counteract the effect thereof. The spring is connected to the arm by means of two cords or links and two rods, arranged at right angles to the axis of the arm and at right angles to each other. When the force of the wind is so great as to cause the vertical sail to swing beyond a vertical line the spring and its connections are brought into operation, and, as the rod to which the spring is connected is in a horizontal position when the spring is first brought into play, the power of the spring is substantially the same at all times during the continuance of the strain upon it.

The power of the spring may be increased or lessened by adjusting the rods to which they are connected, which rods are so arranged that they may be moved inward or outward in their seats in order to increase or diminish their leverage.

When the sails are at rest the counter-balance bars are in a vertical position, and the sails are inclined downward and outward therefrom. When the mill is to be stopped the sails are held in this position and prevented from moving by means of cords or chains attached to the rods, and having their lower ends secured to the shaft or spindle.

The accompanying drawing illustrates one mode of carrying out my invention, Figure 1 being a side elevation, and Fig. 2 a top view.

A represents a vertical shaft or spindle, which may be provided with a step-bearing,  $a^1$ , and a bolster-bearing,  $a^2$ , or may have its bearings arranged in any suitable manner. Near the upper end of the vertical shaft or spindle are one or more cross-heads or bars, B, attached to said shaft, so as to turn therewith. There may be any desired number of these cross-heads or bars, but the two shown are deemed sufficient for illustration. These bars may be arranged to cross each other in line with the axes of the shaft; but they are preferably arranged away from said axes—that is, beside or at the side of said shaft, as shown herein, as thereby their attachment to

the shaft is facilitated and simplified, and they are entirely independent of each other. To each cross-head or bar is connected an arm, C, which carries two sails,  $D^1$   $D^2$ , one at each end. The arm C is loosely arranged in bearings in or on the bar B, so as to allow a reciprocating rotary motion to be imparted thereto by the oscillation of the sails, which are rigidly attached to the arm instead of being loosely connected, as heretofore. The connection here shown consists of links, staples, or screw-eyes  $e$ , which are preferred on account of their simplicity and cheapness, and as presenting less frictional surface than other connecting devices. To the upper side of the arm C are attached two counter-balance bars, F F, one near each end, or between the center and the end of the arm. These counter-balance bars are arranged parallel with each other and at obtuse angles with the planes of the sails. When the sails are at rest or passing from one position to the other the counter-balance bars stand upright, and the sails are inclined downward and outward therefrom, as shown in dotted lines in Fig. 1, and the parts are nicely balanced, so that the slightest current of wind will cause them to assume the proper positions for being operated upon. When the wind is blowing in the direction indicated by the arrow in Fig. 1 the sail  $D^1$  assumes a vertical position, and the other sail,  $D^2$ , a horizontal position, and the counter-balance bars F are inclined in a direction midway between horizontal and vertical, as shown in full lines in said figure. Thus the vertical sail  $D^1$  receives the full force of, and is driven by, the wind, while the horizontal sail  $D^2$  at the opposite end of the arm passes freely against the wind until the said arm has made about half a revolution, when the sails drop to the position shown in dotted lines, and the former positions of the sails are reversed, the sail  $D^2$  assuming a vertical position and causing the sail  $D^1$  to swing upward to a horizontal position.

By this construction and arrangement of parts the sails are rendered reciprocal in their action, and one assists the other in changing position.

Each carrying-arm is provided with a spring and connections for regulating the positions of the sails and speed of rotation under both ordinary and extraordinary force of the wind. The spring may be of any suitable construction and arrangement, but it is here shown as a spiral spring, G, having its lower end secured to the shaft or spindle A. The upper end of the spring is connected, by two cords, chains, or other flexible connections,  $g^1$   $g^2$ , with the outer ends of two rods,  $h^1$   $h^2$ , projecting from the arm C at right angles to each other and to the axis of said arm C.

When any increase or irregularity in the force of the wind occurs the vertical sail  $D^1$  will swing beyond a vertical line, and carry up the horizontal sail  $D^2$ , beyond or above a horizontal

line. The spring G, connected by a cord,  $g^1$ , with the rod  $h^1$ , will yield and allow the sails to move beyond their vertical and horizontal position sufficiently to cause the wind to operate upon the sail  $D^2$  with a depressing or retarding tendency, while it also glances off the inclined sail  $D^1$ , and thus counteracts the effect of the increased force upon the sail  $D^1$ , and preserves the uniformity of speed.

When the positions of the sails become changed, and the sail  $D^2$  becomes vertical, the cord  $g^2$  and rod  $h^2$  operate upon the spring G in the same manner and with the same result as that above described. The rods  $h^1$   $h^2$  are adjustable in their seats, so that they may be moved inward or outward, in order to increase or diminish the leverage according to the strength or tension of the spring G required before the sail will adjust itself to extraordinary wind-force.

To one of the rods  $h^1$  or  $h^2$  of each carrying-arm is attached a cord or chain, J, which passes down through the bolster-bearing of the shaft or spindle through an opening provided for the purpose, and hangs parallel with said shaft.

When the mill is to be stopped the cords J are pulled taut, so as to hold one sail of each arm vertical and the opposite sail of the same arm horizontal, and thus prevent the wind from operating on the sails to carry them around.

The cords J may be provided with hooks or pins  $i$  for securing them when holding the parts, as described.

What I claim as new, and desire to secure by Letters Patent, is—

1. A vertical windmill having its sails in pairs, each pair rigidly secured to a single carrying-arm, loosely attached to or suspended from the shaft or spindle to enable it to have a lateral oscillating motion, substantially as and for the purpose herein described.

2. The combination of the center shaft or spindle A, the cross heads or bars B, carried thereby, and the sail-carrying arms C, suspended from said cross-heads, substantially as herein described.

3. In combination with the center shaft or spindle of a vertical windmill, the arrangement of the sail-carrying arms beside said shaft, substantially as and for the purpose herein described.

4. The combination, with the sails and carrying-arms, of the springs G, adjustable rods  $h^1$   $h^2$ , and cords or connections  $g^1$   $g^2$ , substantially as and for the purpose herein described.

5. The combination, with the shaft and the sails and their carrying-arms, of the cords or chains J, connected with the sail-carrying arms and passing through openings in the bolster  $a^2$ , substantially as described.

A. W. HALL.

Witnesses:

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