(No Model.) 2 Sheets—Sheet 1.

T. O. PERRY.

WINDMILL GOVERNING MECHANISM.

No. 499,394. Patented June 13, 1893.

Fig. 1.

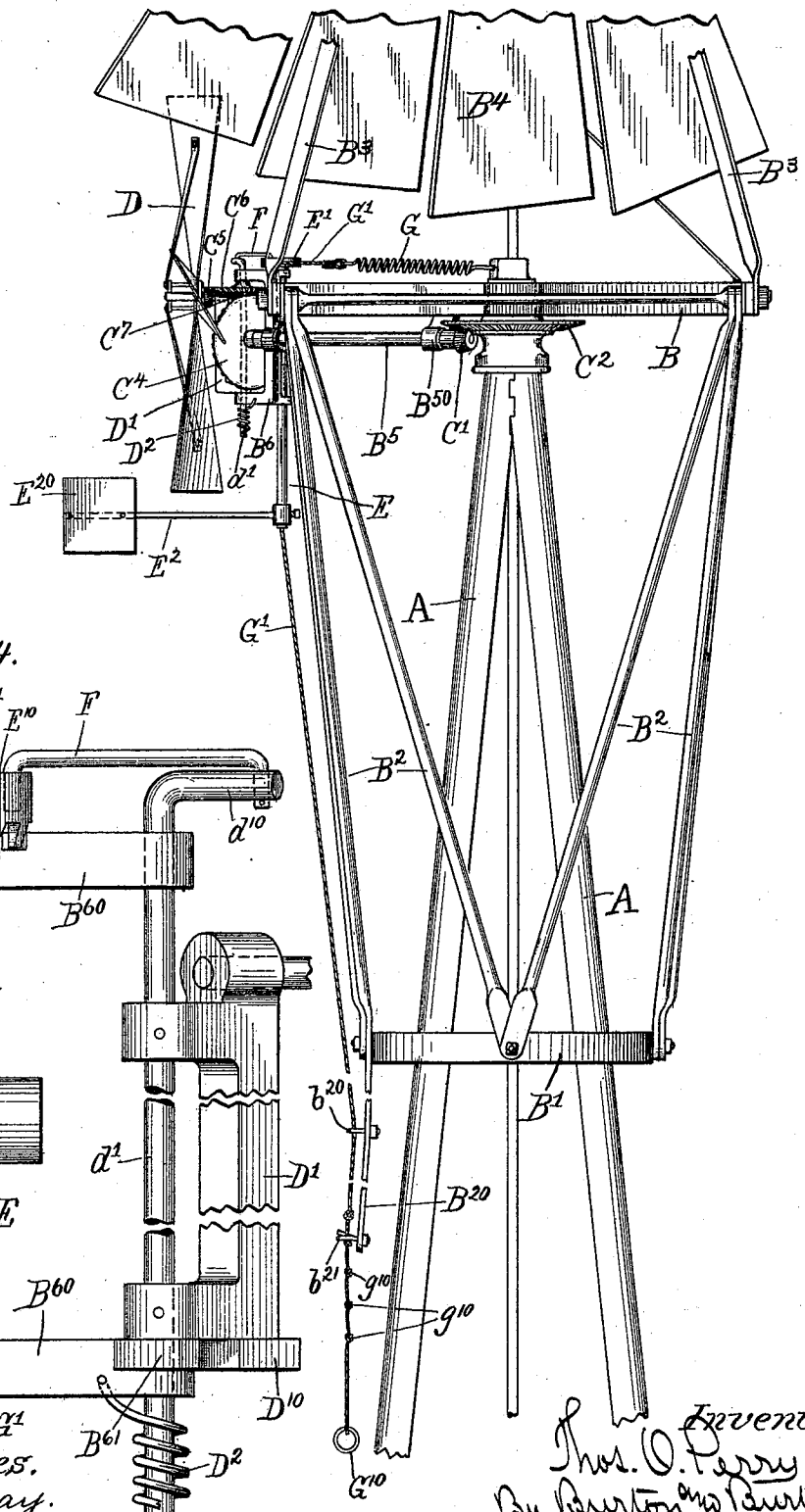

Fig. 4.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

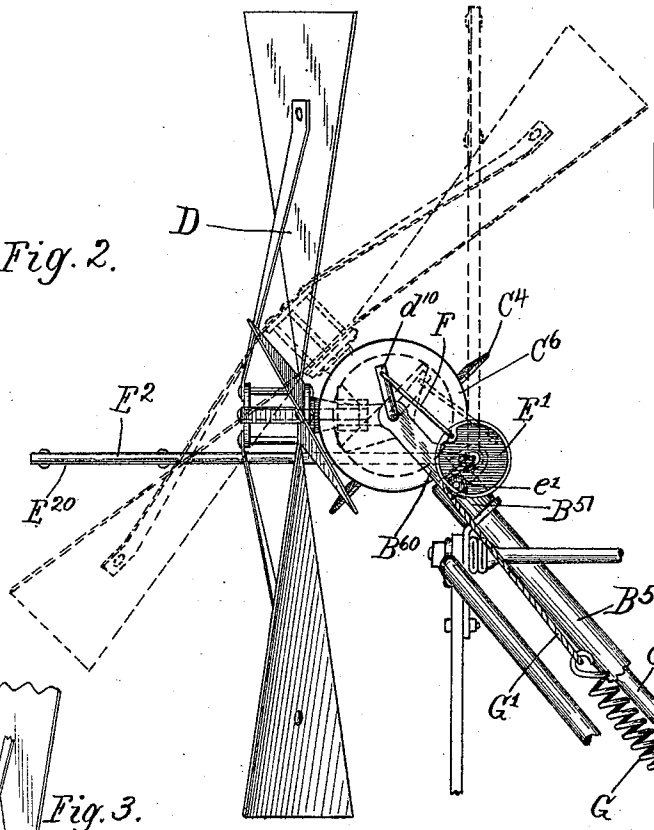


Fig. 6.

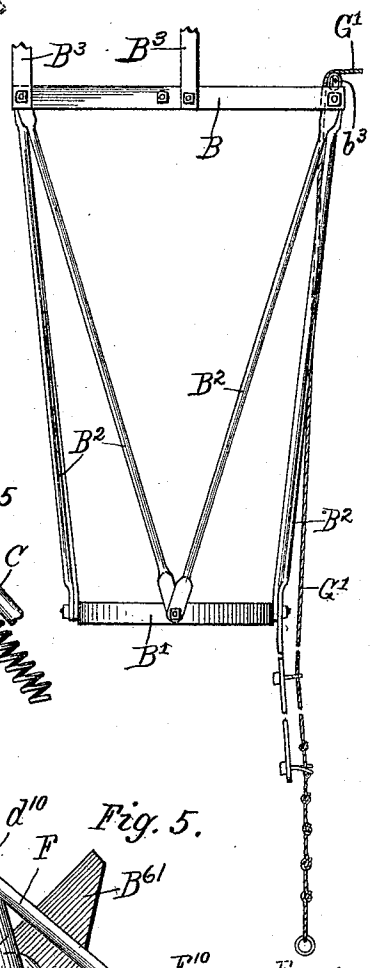


Fig. 3.

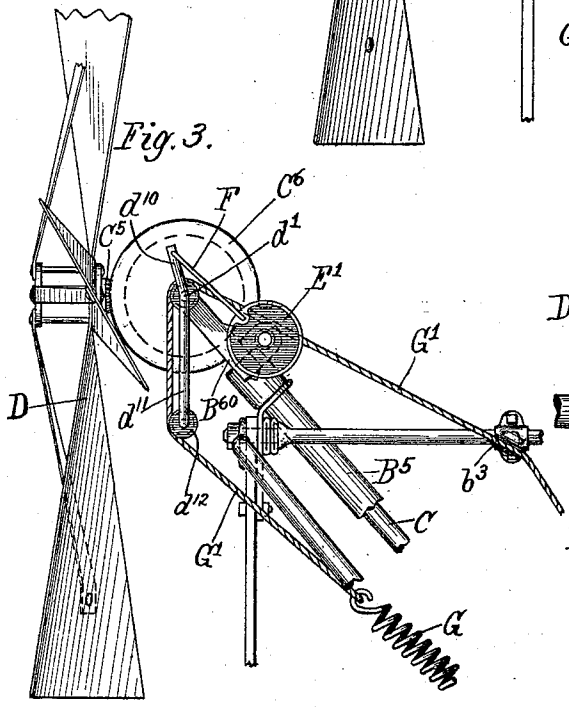
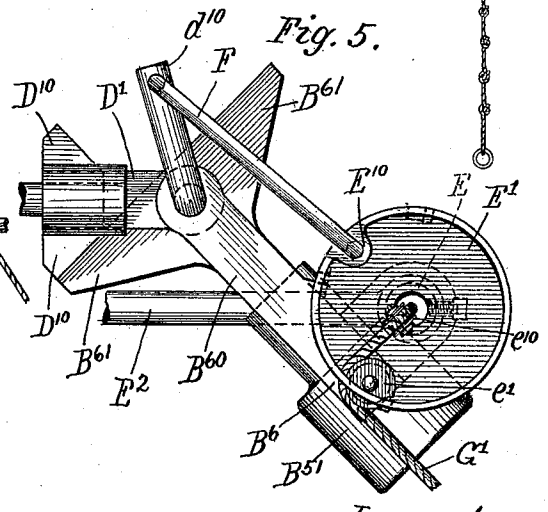


Fig. 5.



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UNITED STATES PATENT OFFICE.

THOMAS O. PERRY, OF CHICAGO, ILLINOIS.

WINDMILL-GOVERNING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 499,394, dated June 13, 1893.

Application filed December 19, 1892. Serial No. 455,673. (No model.)

To all whom it may concern:

Be it known that I, THOMAS O. PERRY, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Windmill-Governing Mechanism, which are fully set forth in the annexed specification, reference being had to the accompanying drawings, forming a part thereof.

This invention is an improvement upon an invention relating to windmills, which is more fully described in my applications, Serial No. 454,162, filed December 5, 1892, and Serial No. 455,720, filed December 19, 1892, and the general construction is illustrated and will be herein explained only so far as necessary to the understanding of the detail improvements. Although these detail improvements are not strictly limited in their applicability to the form of windmill turn-table to which they are shown applied,—which is that shown in my said applications, Serial No. 454,162, filed December 5, 1892, and Serial No. 455,720, filed December 19, 1892, they are most readily represented in such combination. The characteristic of the turn-table in question, to which they are shown applied in the drawings of this application, is that it embodies a horizontal platform which is braced downwardly to a ring which encircles the tower, and which constitutes the means of steadying the platform on the tower, and that it has supports extending upward from it for bearings of the main wheel, which is located above such platform and above the top of the tower.

In the drawings,—Figure 1 is an elevation of the upper end of the tower and the turn-table comprising such platform and downwardly extending braces and governing mechanism mounted thereon, the platform having the upwardly extending supports for the wheel, of which a small segment at the lower side is shown in proper relative position, and the view is a front elevation with respect to the main wheel thus partly represented. Fig. 2 is a detail plan of the governing mechanism, and the corner of the platform at which it is located. Fig. 3 is a similar detail plan representing a slight modification of the means for regulating the governing mechanism. Fig. 4 is an enlarged detail elevation of the governing wheel frame and its bearings at the end of the steering arm of the turn-table, and the motion-reducing connections from said steering frame to the regulating cable, in the form shown in Fig. 2. Fig. 5 is a detail plan of the same. Fig. 6 is a detail elevation of the turn-table platform and downwardly extending bracing framework, showing the course of the controlling cable in the form illustrated in Fig. 4.

A is the tower.

B is the turn-table platform.

B′ is a ring which encircles the tower below the platform.

B^2 B^2, &c., are braces extending up from the ring to the turn-table platform, making the latter rigid with the ring, the ring and braces together constituting a framework which steadies the platform on the tower by means of the bearing of the ring upon the outside of the tower.

B^3 B^3 are bars of the support for the bearings of the main wheel, of which a portion is represented at B^4 on Fig. 1.

B^5 is a steering arm which constitutes part of the turn-table platform, ending at the inner end in a bearing B^{50} and at the other end in the yoke bracket B^6, which comprises a bearing B^{51}, said bearings B^{50} and B^{51} being for the shaft C, which has at its inner end the beveled pinion C′, which meshes with the downwardly facing beveled gear C^2 on the tower top. The other end of the shaft C carries a beveled gear C^4 which, through a train of gears, C^5, C^6 and C^7, receives motion from the governing wheel D, transmitting it through the pinion C′, which, by its engagement with the beveled gear C^2, rotates the turn-table about the tower.

D′ is the steering wheel frame vertically journaled in the yoke arms B^{60} B^{60} of the yoke B^6 at the end of the steering arm, and adapted to swing through ninety degrees about its said bearings, and to be stopped at the limits of that range of motion by the lugs B^{61} B^{61} on the yoke B^6, the steering wheel frame having stop plugs D^{10} D^{10}, adjacent to the lower bearing of the frame in the yoke, and in position to collide with the lugs B^{61} B^{61}, respectively, at the limits of said oscillating movement of the steering wheel frame.

D^2 is a spring coiled about the protruding end of the shaft d' of the steering wheel frame

D′, and having one end connected to said shaft and the other end stopped against the lower arm B^{60} of the yoke B^6 of the steering arm, said spring being coiled in such direction as to tend to hold the steering wheel parallel with the plane of the main wheel, the ninety degrees swinging movement which said governing wheel frame has on its axis, permitting it to move to a position at right angles to the plane of the main wheel.

The mechanism thus far described is that which is embodied in my said applications, Serial No. 454,162, filed December 5, 1892, and Serial No. 455,720, filed December 19, 1892, above mentioned, and its action is more particularly set out in this application, but from the foregoing description it may be understood that when the governing wheel is by any means set at right angles to the plane of the main wheel, the governing wheel will stand edgewise to the wind, and thereby be unrotated by it when the main wheel is facing the wind, and therefore in position to experience the fullest effect of the wind, and that if the wind strikes the governing wheel at an angle tending to rotate it, its rotation will rotate the turn-table through the train of gears described and continue to rotate it until the main wheel faces the wind and the governing wheel stands edgewise to the wind.

Means are herein shown and will be hereinafter described for setting and securing the governing wheel at such angle as may be desired to the main wheel and for retaining it yieldingly in a position at right angles to the main wheel and for varying the force with which it is thus retained, so that it may be forced away from that position whenever the wind is so great that the force which it exerts against the edge of the governing wheel and other devices which may be connected with it, as to overcome the yielding force which thus retains the governor wheel at right angles to the main wheel, and the main wheel at right angles to the wind, such yielding force being presumably adjusted so that it may be overcome when the wind is such that its entire force against the full face of the main wheel would give the latter too violent action. This invention relates to the details of the mechanism by which the angle of the governing wheel to the main wheel is regulated and its action as a governing wheel controlled.

For the purpose of understanding the necessity which this invention is designed to meet, we may consider the operation of the structure when the main wheel is facing the wind and the governing wheel is edgewise to the wind, as shown in Fig. 1, and by the full lines in Fig. 2. Any yielding force being, for the present, supposed to be operating to hold the governing wheel in that position, overcoming for that purpose the contrary force of the spring D^2, a violent and sudden gust of wind striking the edge of the governing wheel will sometimes swing it instantly away from the direction of the wind, so that it will stand with its back to the wind parallel to the plane of the main wheel, and in this position receiving the full force of the wind, it will be rotated rapidly backward, and will thereby feed the main wheel around the turn-table until it stands edgewise to the wind, causing it to come to rest, or even with its back to the wind, thus reversing its motion, before the governing wheel will recover itself and feed the main wheel back to a proper angle to the wind. The main wheel is liable thus to fluctuate excessively instead of being regulated to a uniform speed in varying wind. To overcome this difficulty is one purpose of this invention which accomplishes the result by means which I will now describe. On the yoke B^6, at the end of the steering arm, in lugs B^{62} B^{62}, I journal the vertical counter shaft E, at the upper end of which I secure a crank wheel E′, which, in one form of my invention, is also a sheave or drum, and from said crank wheel at the crank pivot or wrist E^{10}, I extend a link F, connected to a crank arm d^{10} of the shaft d' of the governing wheel frame D′. The radial distance of the crank wrist E^{10} from the axis of the shaft E, is less than the length of the crank d^{10}, measuring the latter from the axis to the crank center. The crank wrist E^{10}, the link F, and the crank d^{10}, constitute, it will be seen, motion-reducing connections from the shaft E to the shaft d', the angular motion which the latter shaft derives from the former through said connections being less than that of the former shaft; and the purpose of thus interposing these connections is to cause the angular motion of the vane carried by one of the shafts to produce a less angular motion of the other shaft which carries the governor wheel frame. As I have illustrated it, and as I prefer to employ it, the length of the crank d^{10} is nearly double the radial distance of the crank wrist E^{10}. The controlling spring G may be connected so as to operate upon either the shaft d' or the shaft E, both methods being herein illustrated, and both will be hereinafter particularly described. From the lower end of the shaft E, I extend the arm E^2, underneath the governing wheel D, and at its extremity I provide it with the vane E^{20}. The relative directions and lengths of the arm E^2, the crank d^{10}, and the link F, are such that when the wheel D stands at right angles to the plane of the main wheel, the arm E^2 stands parallel to said plane. This position is shown in Fig. 1 and by the full lines in Fig. 2. In case of a violent gust of wind striking the edge of the governing wheel D, it will strike the face of the vane E^{20} at right angles thereto. The leverage which the vane E^{20} obtains by the length of the arm E^2 from the axis of the shaft E, is several times as great as the leverage of the wheel D, by reason of its mean distance from the pivotal axis of its frame D′, and the size of the vane E^{20} is such that of the force tending to overcome the spring G, that which is derived from

the pressure of the wind against the vane E^{20} is much greater than that derived from the pressure of the wind against the governing wheel. When, therefore, a sudden gust of wind strikes the wheel edgewise and the vane at right angles, it may swing the vane to a position parallel with the wind, but can swing it no farther, and having swung it to that position, the whole force derived through the vane to overcome the spring G is lost. By reason of the connections described between the governing wheel frame shaft and the shaft E of the vane proportioned as indicated, the ninety degree movement of the vane will cause only about forty-five degrees movement of the governing wheel, so that the effect of a sudden powerful gust of wind will be to bring the governing wheel to a position oblique, and at about forty-five degrees, to the wind while the vane goes to a position parallel with the wind. These positions, relatively to the original positions, are shown in dotted line in Fig. 2. The governing wheel, being thus set and held in such oblique position, will be rotated moderately only, even by a violent wind, and will rotate the turn-table and main wheel gradually to the position in which the main wheel is oblique to the wind, thus regulating the speed of the latter. It will be understood, of course, that a less violent wind striking against the vane and governing wheel may carry the vane to a position oblique to the wind, instead of a position fully parallel and the governing wheel to a position correspondingly less oblique to the wind and exposed to a less proportion of its force, and adapted, therefore, to rotate the turn-table to swing the main wheel less rapidly and to a less degree out of the wind. If the wind continues sufficiently violent, the governing wheel may swing through the entire ninety degrees which is its full range of motion about the pivot of its frame, but the portion of that movement which it makes after the vane E^{20} is parallel to the wind, it will, of necessity, make gradually, which will result in a complete regulation of the main wheel instead of throwing it entirely out of the wind, and stopping and even reversing it before it comes back to its proper position. And although, theoretically, the governor wheel may move to a position parallel with the main wheel, the vane moving through one hundred and eighty degrees about its axis and standing parallel with it, this will happen only when both the vane and the governing wheel are parallel with the main wheel,—that is it will happen only when the wheel has been brought very gradually to a position edgewise to the wind and thereby brought to rest. And, in practice, since the spring G will be made strong enough to require the pressure of a strong wind against both the edge of the governor wheel and full against the face of the vane in order to start the governor wheel frame away from the position of rest of said wheel, and since the tension of the spring, resisting such movement, increases as the movement proceeds, while the force derived from the wind pressure against the vane diminishes, and finally is wholly lost by the time the governor wheel has swung through forty-five degrees,—it is evident that in practice, the spring G may be so proportioned to the other parts as to prevent the main wheel coming to rest in any wind which the tower can withstand, or swinging around farther than to compensate by its diminished exposure to the wind, for the increased velocity of the latter, and to maintain the speed of the main wheel substantially uniform.

The experience of those familiar with the art, and a little experiment by those of less experience, will enable them to properly adapt the spring G, in respect both to its initial tension and the rate of increase of tension as it is strained, to the necessities of the case, so that practically uniform action of the main wheel will be obtained. The spring G is secured at one end to the turn-table, and a cable G′ from the other end extends optionally to a guide or point of connection eccentric with respect to the axis of the shaft E, or eccentric with respect to the axis of the governor wheel frame. In Figs. 1, 2, 4 and 5, I have shown it acting in this manner upon the shaft E, the crank wheel or drum E′ at the upper end of that shaft having a guide pulley e' at the circumference of the drum or sheave, and a cable from the spring passing around said guide pulley and over a guide pulley e^{10} at the center of the sheave down through the hollow shaft E, and emerging from the lower end of said shaft, extending thence down alongside the brace frame which includes the ring B′ to a guide eye b^{20}, secured at any convenient point on this brace frame. A convenient means for obtaining support for said guide eye is to form an extension B^{20} of one of the brace bars B^2 down below the ring, bending it out to correspond with the slant of the tower, and producing it to within any necessary distance of the ground. The lower end of the cable G′, being provided with a hand ring G^{10}, may be as high above the ground as a man may reach, but the guide eye b^{20} may be many feet above that point without risk of snarling the depending end of the cable. The cable, being pulled down to any desired extent, will increase the tension of the spring accordingly, without changing the position of the sheave or crank wheel E′, and on the other hand, the rotation of the crank, when under the action of the governing wheel, will cause the cable to draw only upon the spring, and not to draw upon the downwardly extending portion, because the latter passes through the center of the crank wheel. To secure the lower end of the controlling or furling cable G′, any convenient means may be employed. A simple expedient which makes it possible to stop short the extension B^{20} considerably above the hand ring G^{10}, consists in providing on the same

extension B^{20}, a fork b^{21}, and providing on the cable several knots g^{10} g^{10}, &c., at short distances apart. The operator standing on the ground can readily release one knot from the fork and engage another one above or below it, thus reducing or increasing the tension of the spring. This expedient dispenses with the necessity for the swivel devices and expedients of like nature for connecting the furling rods or cords when they extend down within the tower.

In Fig. 3, I have shown the spring G operating upon a shaft of the governor wheel frame. For this purpose, a horizontal arm d^{11} is extended out from the shaft d' in a vertical plane at an angle of ninety degrees to the vertical plane in which the stud axle of the governor wheel is located, and on the end of this lever arm d^{11} is journaled a pulley d^{12}, around which the cable G′ from the end of the spring G extends to and around a similar guide pulley on the shaft d' just below the arms d^{10} and d^{11}, and from thence, the cable extends to a guide pulley b^3, mounted at any convenient point on the turn-table platform, and when that platform is an open frame, as herein shown, the pulley may be located, as illustrated, so that the cable in passing over the pulley passes over the outer bar of the frame, and thus down through the platform, emerging outside of the ring B′, and being guided on an extension of one of the bars B^2, as in the first-described construction.

It will be understood that the expedient of passing the cable through the hollow shaft which is shown in the figures wherein the cable is made to act on the shaft E, would be equally applicable to the construction wherein the cable acts on the shaft of the governing wheel frame, and specific illustration of its application to that situation is unnecessary.

I claim—

1. In a windmill, in combination with the tower, the turn-table, the main wheel; the governor wheel frame pivoted to the turn-table; the governor wheel journaled on said frame and geared to the tower; a counter-shaft on the turn-table, and motion-reducing connections from said shaft to the shaft of the governor wheel frame; and a vane carried by such counter-shaft; a spring which holds the vane yieldingly facing the same way as the main wheel; whereby the vane, in moving under the pressure of the wind against the tension of the spring, causes the governor wheel to move through a less angle: substantially as set forth.

2. In a windmill, in combination with the tower, the turn-table; the main wheel; the governor wheel frame, and the governor wheel journaled thereon and geared to the tower; a counter-shaft on the turn-table, and a vane carried by such counter-shaft, and a spring which holds it yieldingly in position substantially parallel to the plane of the main wheel; motion-reducing connections from the counter-shaft to the governor wheel frame shaft, by which ninety degrees movement of the counter-shaft causes substantially forty-five degrees movement of the governor wheel, as and for the purpose set forth.

3. In combination with the tower, the turn-table; the main wheel; the governor wheel frame pivoted to the turn-table: the governor wheel journaled on said frame and geared to the tower; a counter-shaft on the turn-table, and a link eccentrically connected at one end to said counter-shaft, and more eccentrically connected at the other end to the governor wheel frame; whereby reduced angular movement is communicated from the counter-shaft to the governor wheel frame; a vane carried by the counter-shaft, and a spring which tends to hold the vane yieldingly at an angle to the governor wheel and facing the same way as the main wheel: substantially as set forth.

4. In combination with the tower, the turn-table; the main wheel; the governor wheel frame pivoted to the turn-table and the governor wheel journaled on said frame and geared to the tower; a counter-shaft on the turn-table carrying a vane; motion-reducing connections from said counter-shaft to the governor wheel shaft; and a spring reacting at one end upon the turn-table, and suitable connections from the other end to cause it to act upon the counter-shaft with a tendency to rotate the latter and hold it yieldingly in position to cause its vane to face the same way as the main wheel: substantially as set forth.

5. In a windmill, in combination with a tower, the turn-table; the main wheel; the steering or governing device supported by the turn-table and pivotally connected thereto; a spring connected at one end to the turn-table, and a cable extended from the other end about suitable guides on the pivoted frame of the steering device or parts having operating connection therewith and from such guides downward toward the base of the tower to afford means for regulating the tension of the spring: substantially as set forth.

6. In combination with a tower, the turn-table, the main wheel; the frame which supports the steering device; a vertical shaft on the turn-table whose rotation rotates the frame of the steering device; a spring connected at one end to the turn-table; a furling cable extending from the other end of the spring around a guide eccentrically situated with respect to said shaft on an arm thereof, and thence over a guide at the center of said shaft, and thence over suitable other guides toward the base of the tower; and means for securing the lower end, whereby the tension of the spring may be adjusted by the furling cable and the latter secured at the lower end: substantially as set forth.

7. In combination with the tower, the turn-table; the main wheel; the steering frame pivoted to the turn-table and carrying a suitable steering device; a spring connected at one end

to the turn-table and a furling cable extending from the other end over a guide from which the reaction of the spring is transmitted to the steering frame, and thence over suitable guides downward outside the tower toward the base thereof, and a suitable device for securing the cable against the tension of the spring; whereby the tension of the spring may be adjusted and the main wheel regulated by a furling cable outside the tower: substantially as set forth.

8. In combination with the tower and the turn-table thereon, a ring rigid with the turn-table and encircling the tower at a distance below the top of the latter; the steering frame pivoted on the turn-table; a spring connected at one end to the turn-table, and a furling cable connected at the other end to the spring, and extending over a guide from which the reaction of the spring is transmitted to the steering frame; thence over other suitable guides downward through a guide carried by said ring, and suitable means for securing the furling cable in fixed position with respect to the ring; substantially as set forth.

9. In combination with the tower, the turn-table comprising a ring rigid with it and encircling the tower at a distance below the top; the steering mechanism and the spring which controls the same on the turn-table, and the furling cable extending from the spring outside the tower, and a guide for the cable fixed with respect to the ring, and means for securing the cable below such guide: substantially as set forth.

10. In a windmill, in combination with the tower and turn-table, the steering or governing mechanism and a furling cable which controls the same; an arm rigid with the turn-table extending therefrom downward outside the tower, and a guide and securing devices for the furling cable thereon, whereby the wheel may be regulated from the outside of the tower: substantially as set forth.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 7th day of December, 1892.

THOMAS O. PERRY.

Witnesses:
CHAS. S. BURTON,
JEAN ELLIOTT.