Oct. 27, 1925.

1,558,645

H. TERHORST

WINDMILL

Filed May 17. 1924

Fig. 1.

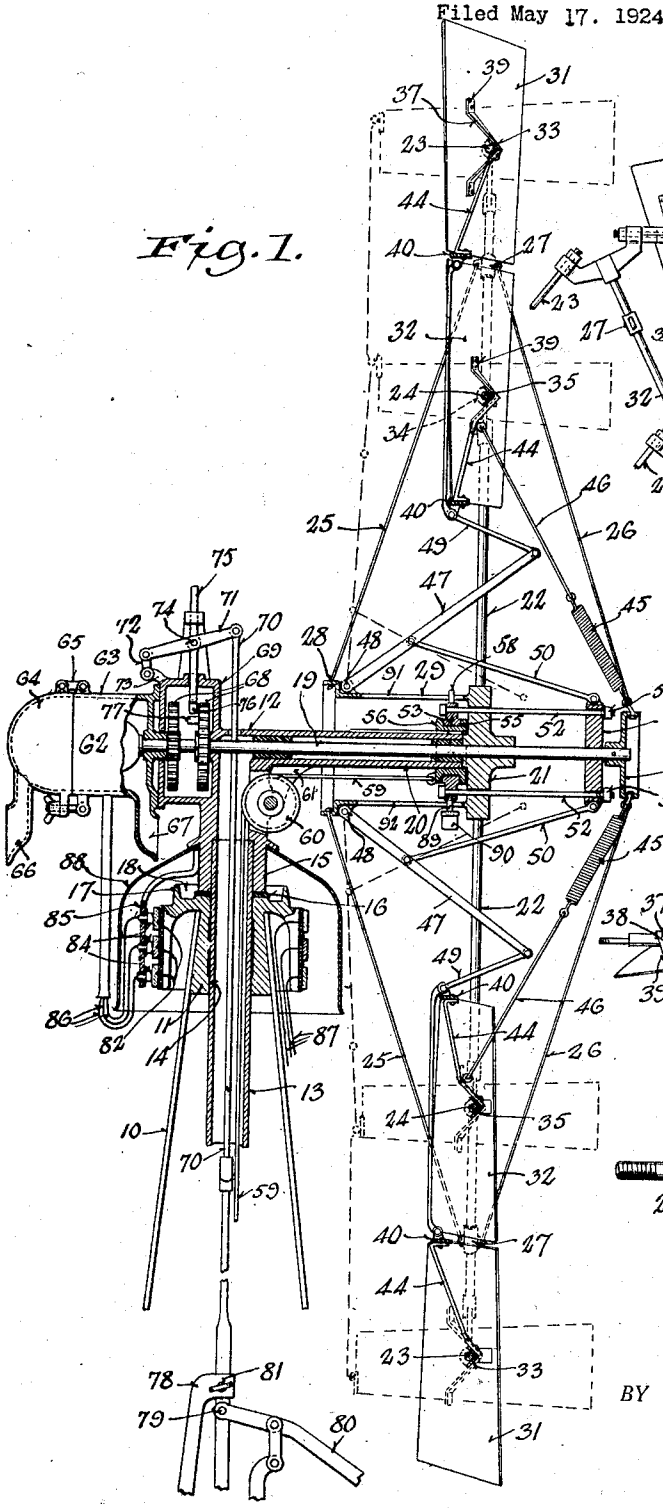


Fig. 2.

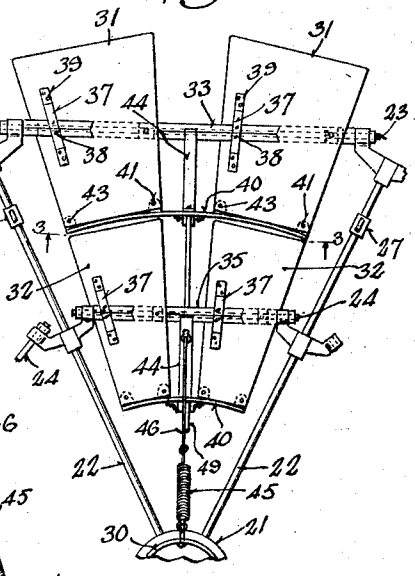


Fig. 3.

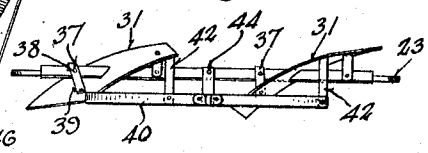
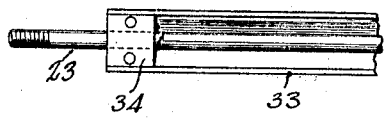


Fig. 4.



INVENTOR.

HARVEY TERHORST

BY

Ralph W. Brown.

ATTORNEY.

Patented Oct. 27, 1925. 1,558,645

UNITED STATES PATENT OFFICE.

HARVEY TERHORST, OF DONNYBROOK, NORTH DAKOTA.

WINDMILL.

Application filed May 17, 1924. Serial No. 713,943.

To all whom it may concern:

Be it known that I, HARVEY TERHORST, a citizen of the United States, residing at Donnybrook, in the county of Ward and State of North Dakota, have invented a certain new and useful Improvement in Windmills, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to windmills for use, primarily, in farm lighting plants.

One object of the present invention is the provision in a windmill wheel of a number of adjustable vanes or blades of a size permitting easy manipulation within a limited operating space and so arranged that, when presented to the wind, they combine to form relatively large and efficient sail areas.

Another object is the provision of a simple yet sturdy mounting for the several blades.

Another object is the provision of improved reefing mechanism by which the blades may be shifted into and rigidly held in fully reefed position by a relatively light pull on the reefing cable.

Another object is the provision in a constant speed windmill wheel of a novel arrangement of parts in which the control elements for the reefing mechanism is free from strain during the automatic governing action of the wheel.

Another object is the provision of improved pump operating mechanism in which the pump rod may be rendered active or inactive by a simple manipulation of the operating parts.

Another object is to improve the construction and mounting of the revolving head of the windmill and provide improved electrical connections for the generator carried thereby.

Other objects and advantages will appear from the following description of an illustrative embodiment of this invention.

In the accompanying drawings:

Figure 1 is a vertical sectional view of a windmill constructed in accordance with the present invention.

Figure 2 is a rear elevation of a portion of the windmill wheel.

Figure 3 is a view taken substantially along the section line 3—3 of Figure 2.

Figure 4 is a detail of one end of a blade supporting bar.

The windmill shown comprises the usual tower 10 having a casting 11 rigidly fixed to the top thereof and forming a seat for a revolving head 12. A hollow stem or spindle in the form of a pipe 13 is fixed in the head 12 and projects through a central vertical bore 14 in the casting 11 in which the pipe is fitted for rotation. The base 15 of the head 12 rests upon a large bearing washer 16, interposed between the head and the upper face of the casting. An upturned circular flange 17 formed integral with and surrounding the upper face of the casting 11 provides a basin 18 for retaining sufficient lubricant to keep this bearing well oiled.

The shaft 19 of the windmill is journaled in a rigid arm 20 formed integral with and extending horizontally from the head 12. A hub 21 is fixed to the shaft 19 adjacent the outer end of arm 20. A series of spokes 22 are anchored at their inner ends in the hub 21 and extend radially therefrom. The spokes are connected by two series of tie rods 23 and 24 and each spoke is braced by a pair of guys 25 and 26, both of which extend inwardly from a bracket 27 fixed to the spoke. Guys 25 are anchored at their inner ends to the end 28 of a hollow sleeve-like extension 29 of the hub 21 and guys 26 are fixed at their inner ends to a spider 30 fixed to the outer end of the shaft 19.

Two concentric circular series of vanes or blades 31 and 32 are supported by and between the spokes 22. The blades of each series are arranged in groups of two between successive spokes each group being mounted to swing about a chordal axis. Each group of blades 31 of the outer series are fixed to a bar 33 in the form of an angle section having small castings 34 fixed in the ends thereof and bored to rotatably receive the tie rod 23. Each group of blades 32 of the inner series are fixed to a similar bar 35 similarly mounted upon the tie rod 24. The blades are of sheet metal and each is suitably punched to permit the bar 33 or 35 and tie rod to pass snugly therethrough. Each blade is fixed to its supporting bar by a strap 37 suitably bent and riveted as at 38 to the two sides of the bar and riveted at its ends 39 to the face of the blade. A strip of metal 40 connects the lower ends of the blades of each pair. Each strip 40 is riveted as at 41 to one lower corner of each blade and pieces 42 connect the other lower corners 43 of the blades to the strip 40. A

bar 44 connects each of the bars 33 and 35 with the strip 40 between the blades carried thereby. Each pair of blades of the outer series is connected to the corresponding pair of blades of the inner series through a link 44 pivotally connected at its opposite ends to the strips 40.

The arrangement is such that each pair of blades can swing with their supporting bar 33 or 35 about the longitudinal axis of the bar from the full line position of Figures 1 and 2, in which they offer a maximum effective area to the wind, to the dotted line position of Figure 1 in which they lie substantially parallel to the direction of the wind. It will be noted that when in the full line position of Figures 1 and 2 each blade 31 of the outer series registers at its inner end with the outer end of a blade 32 of the inner series so that the two present a single substantially unbroken surface to the wind. This is a condition most favorable for efficient operation and is the position normally assumed by the blades during periods of low wind velocities. The blades are yieldably retained in this position by a series of springs 45 each connected at one end to the spider 30 and at the other end through a wire 46 with the bar 44 of an inner pair of blades.

Each group of blades are so mounted that the center of gravity thereof lies inwardly and somewhat in advance of the axis of their supporting bar 33 or 35 so that the centrifugal force resulting from rotation of the wheel tends to rock the blades from the full line toward the dotted line position of Figure 1 against the tension of the springs 45. The tension of the several springs is so set as to hold the blades in the full line position shown so long as the wheel velocity is below a predetermined minimum. Above this minimum the springs yield and permit the blades to tilt and spill the wind. This substantially reduces the speed of the wheel. In this manner, the speed of the wheel is maintained substantially constant at various wind velocities.

Mechanism is preferably provided for adjusting the blades manually toward or into the dotted line position of Figure 1. In the windmill shown, mechanism for this purpose comprises a series of arms 47 each mounted upon a pivot pin 48 fixed in the hub extension 29, so as to swing in a radial plane intermediate a pair of spokes 22. Each arm 47 is connected through a link 49 with a strip 40 of a pair of inner blades 32. Each arm is also connected through a link 50 with a collar or disk 51 slidable upon the shaft 19. A pair of rods 52 pass loosely through the disk 51 and hub 21. Each rod 52 is fixed at one end to a ring 53 and at its other end carries a nut 54. Ring 53 is rotatably mounted in an annular groove 55 provided in a collar 56 slidable upon the arm 20. A pin 58 and the hollow stem 89 of a grease cup 90, projecting radially through longitudinal slots 91 and 92, respectively, of the hub extension 29, are anchored in the ring 53 and cooperate with the hub extension to cause rotation of the ring therewith. Collar 56 is held against rotation upon the arm 20 by a splined connection therewith permitting the collar to slide longitudinally thereon. A reefing cable 59 connected at one end to the collar 56 passes over a pulley 60, journaled in and between a pair of spaced reinforcing webs 61, and down through the hollow stem 13 to the ground. By pulling the cable 59, the collar 56, ring 53 and rods 52 may be shifted the desired distance toward the left in Figure 1. This movement of the rods 52 is transmitted through the nuts 54 to the disk 51 to thereby move the links 50, arms 47, and links 49 toward the left to tilt the blades out of the wind. When the collar 56 is in the position shown in Figure 1, the disk 51 is free to move along the shaft 19 and rods 52 to permit the blades to automatically adjust themselves to the velocity of the wheel and wind in the manner hereinabove described. It will be noted that during this automatic governing action of the blades the collar 56 and ring 53 are unaffected by the movement of the disk 51, and are therefore absolutely free of strain and wear and tear during this action.

It will be noted that each of the arms 47 and connected links 49 are so disposed as to form a straight line connection between the pivot 48 of the hub extension 29 and the connecting strip 40 when the blades are in the fully reefed position as indicated in dotted lines in Figure 1, so that they provide an extremely rigid securing means by which the blades are effectively held against vibration and rattling. In this position, only a very slight tension in the reefing cable 59 is necessary to retain the blades in fully reefed position. As the arms 47 and links 49 move from the full line position shown this toggle action becomes more and more effective to move the blades against the increasing resistance of the springs 45, so that the tension in the reefing cable, necessary to effect this movement, becomes less as the blades approach the fully reefed position.

The revolving head 12 carries an electric generator 62 enclosed in a casing 63. The casing shown is provided with an end cover 64 hingedly connected through a link 65 with the casing so that the cover may be swung upwardly and rested upon the top of the casing. The enclosed parts are thus rendered easily accessible even to the repairman who finds it necessary to hang onto the tower with one hand while he is

readjusting or replacing the generator brushes. The opposite ends of the casing are preferably provided with ventilators 66 and 67. The generator is driven through appropriate gearing 68 disposed in the casing 69.

The usual pump rod 70 is provided for operating a pump not shown. Rod 70 is connected at its upper end to a lever connected at one end through a link 72 with a bracket 73 secured to the gear casing 69. Lever 71 is operatively connected through a pin 74 with a plunger 75 vertically reciprocable in the upper wall of the gear casing. A shoe 76 on the lower end of plunger 75 normally bears upon a roller 77 eccentrically mounted upon one of the gears 68. The arrangement is such that during rotation of gear 68 the roller 77 imparts a vertical reciprocation to the plunger 75 and consequently the pump rod 70. The rod 70 at its lower end passes through the usual pump bracket 78 and connects through a pin 79 with the pump handle 80. By depressing the pump handle the rod 70 may be raised sufficiently to cause the shoe 76 on plunger 75 to clear the roller 77. This obviously brings the pump rod 70 to rest. The rod is then secured in this position by passing a pin 81 therethrough above the bracket 78. The pump and rod are thus rendered inactive until the pin 81 is again removed.

A very convenient means for connecting the generator 62 with the ground circuit is provided in the windmill shown. This means comprises three contact rings 82 mounted on and insulated from a series of depending lugs formed upon the casting 11. Three brushes 84 in contact with the rings, respectively, are mounted on and insulated from a bracket 85 fixed to the stem 15 of the revolving head 12. The several brushes are connected to the generator through separate leads 86 and the rings 82 are connected with the work circuit through the three separate leads 87. An enclosing cover 88, fixed to the stem 15, protects these parts from the weather.

Various changes may be made in the embodiment of the invention hereinabove described, without departing from or sacrificing any of the advantages of the invention as defined in the appended claims.

I claim:

1. In a windmill wheel the combination of a hub, a circular series of blades disposed about said hub, a second circular series of blades disposed about said hub within said first series, each blade of one series adapted to register with a blade of the other series to form in effect an extension thereof, and supports for the blades of both series permitting said blades to rock into and out of the plane of said series.

2. In a windmill wheel the combination of a hub, a circular series of blades arranged in groups about said hub, a second circular series of blades arranged in groups about said hub within said first series, each blade of one series adapted to register with a blade of another series to form in effect an extension thereof, and a pivotal support for each group of blades permitting them to rock about chordal axes.

3. In a windmill wheel the combination of a hub, a series of spokes mounted on said hub, two substantially parallel bars between each adjacent pair of spokes, and a group of blades mounted on each bar and rockable about the axis thereof, each blade of each group adapted to register with a blade of an adjacent group to form in effect an extension thereof.

4. In a windmill wheel the combination of a hub, a series of spokes mounted thereon, bars of angular form rockably supported between successive spokes, blades mounted on said bars and pierced thereby, and straps rigidly connecting the bars and blades.

5. In a windmill the combination of a shaft, a hollow hub fixed thereto having a hollow extension, a support for said shaft projecting into said extension, a series of blades carried by said hub and mounted to swing about chordal axes, a series of arms pivotally mounted on said extension and connected with said blades, a ring within said hub movable axially thereof, interengaging means between said ring and hub to cause said ring to rotate with said hub and connections between said ring and arms through which said blades are rocked in response to axial movement of said ring.

6. In a windmill the combination of a shaft, a hollow hub fixed thereto and having a hollow extension, a series of blades carried by said hub and mounted to swing about chordal axes, a series of arms pivotally mounted on said extension and connected with said blades, a ring within said hub movable axially thereof, lugs on said ring engaging said hub to cause said ring to rotate therewith, an element movable axially of said hub and connected with said arms, and connections between said ring and element.

7. In a windmill wheel the combination of a shaft, a hollow hub fixed thereto, a series of blades carried by said hub automatically adjustable with changes in wind velocity to maintain the speed of the wheel substantially constant, a ring axially movable within said hub, lugs on said ring engaging said hub to cause said ring to rotate therewith, operating connections for said blades movable therewith and including an element movable axially of said hub, and connections between said ring and element through which said blades are adjusted by

movement of said ring and permitting said automatic adjustment of said blades without disturbing the position of said ring.

8. In a windmill wheel the combination of a series of blades mounted to rock about chordal axes, means for yieldably retaining said blades in one position, mechanism for rocking said blades against the action of said yieldable means, a member under the control of the operator movable axially of the wheel for actuating said mechanism, and connections between said actuating member and mechanism permitting said blades to rock by centrifugal force without disturbing the position of said actuating member.

9. In a windmill the combination of a shaft, a wheel secured thereto having a series of rockable blades, means for yieldably retaining said blades in one position, mechanism for rocking said blades against the retaining action of said means, a ring movable axially of the wheel for actuating said mechanism, and connections between said ring and mechanism permitting said blades to rock by centrifugal force against the restraining action of said means without disturbing the position of said ring.

10. In a windmill the combination of a shaft, a wheel thereon for driving said shaft, a member driven by said shaft, an element eccentrically disposed on said member, a pump rod, means normally actuated by said element for driving said pump rod said pump rod being movable to lift said means out of operative relation with said element to render said pump rod inactive and means for releasably retaining said pump rod in inactive position.

11. In a windmill wheel the combination of a shaft, a hub thereon having a hollow extension, a support for said shaft projecting into said extension, rockable blades supported by said hub, arms carried by said extension for rocking said blades, and means movable axially of said hub for adjusting said arms.

12. In a windmill wheel the combination of a hollow hub, rockable blades carried thereby, a ring axially movable within said hub, driving connections between said hub and ring, operating connections between said ring and blades, and means for shifting said ring to rock said blades.

13. In a windmill wheel the combination of a hollow hub, rockable blades carried thereby, a ring axially movable within said hub, an element movable axially of said hub independently of said ring, operating connections between said element and blades, and connections between said element and ring for shifting said element and rocking said blades when said ring is shifted in one direction.

14. A windmill wheel comprising a plurality of concentric series of blades, each blade of one series being so shaped and disposed as to register with a blade of another series to normally form therewith a substantially continuous sail area, and pivotal supports for said blades permitting the same to be rocked into position with their edges toward the wind and to break said sail areas.

15. A windmill wheel having a radial series of spokes, tie rods connecting successive spokes, a set of blades associated with each tie rod, and a unitary supporting member for each set of blades pivotally mounted on said associated tie rod and connecting the blades of a set to form an operating unit.

16. In a windmill wheel the combination of a hub, a radial series of spokes mounted thereon, sets of blades between successive spokes, a pivotal support for each set of blades comprising a bar of angular cross-section piercing said blades, members rigidly connecting said blades and bar, and a member rigidly connecting the ends of the blades of a set.

17. In a windmill wheel the combination of a hub, a series of radial spokes carried thereby, bars pivotally mounted between successive spokes, a set of blades carried by each bar, rigid connections between the blades of each set and said bar, a member adjacent the ends of the blades of each set connecting corresponding corners thereof, and ties connecting said member with other corresponding corners of the blades of each set.

18. A windmill wheel comprising a plurality of concentric series of blades pivotally supported to rock into and out of the wind, each blade of each series being so shaped and disposed that the surface thereof constitutes a continuation of the surface of an adjacent blade of another series and to form therewith a relatively large sail area when turned to the wind, and means for rocking said blades out of the wind to thereby break said sail areas.

19. A windmill wheel having a plurality of concentric series of blades pivotally supported to rock into and out of the wind, the inner end of each blade of an outer series being substantially co-extensive with the outer end of a blade of the next inner series and adapted to register therewith to form an extended sail area when turned to the wind, and means for rocking said blades out of the wind to thereby break said sail areas.

20. In a windmill the combination with a tower, of a member having a portion fixed within the top of said tower, and a depending portion surrounding said tower, contact rings carried by said depending portion, a member rotatably supported by said first named member, a wind wheel carried thereby, an arm depending from said rotatable member, and elements carried by said arm in contact with said rings, respectively.

21. In a windmill the combination with a tower of a casting having a portion fixed within said tower and a depending portion outside of said tower, a rotatable member, a wind wheel carried thereby, an annular seat on said casting for supporting said member, an annular oil basin surrounding said seat, contact rings carried by said depending portion, contact elements carried by said member bearing upon said rings respectively, and a cover carried by said member enclosing said oil basin and contact rings.

In witness whereof, I hereunto subscribe my name this 15th day of May, 1924.

HARVEY TERHORST.