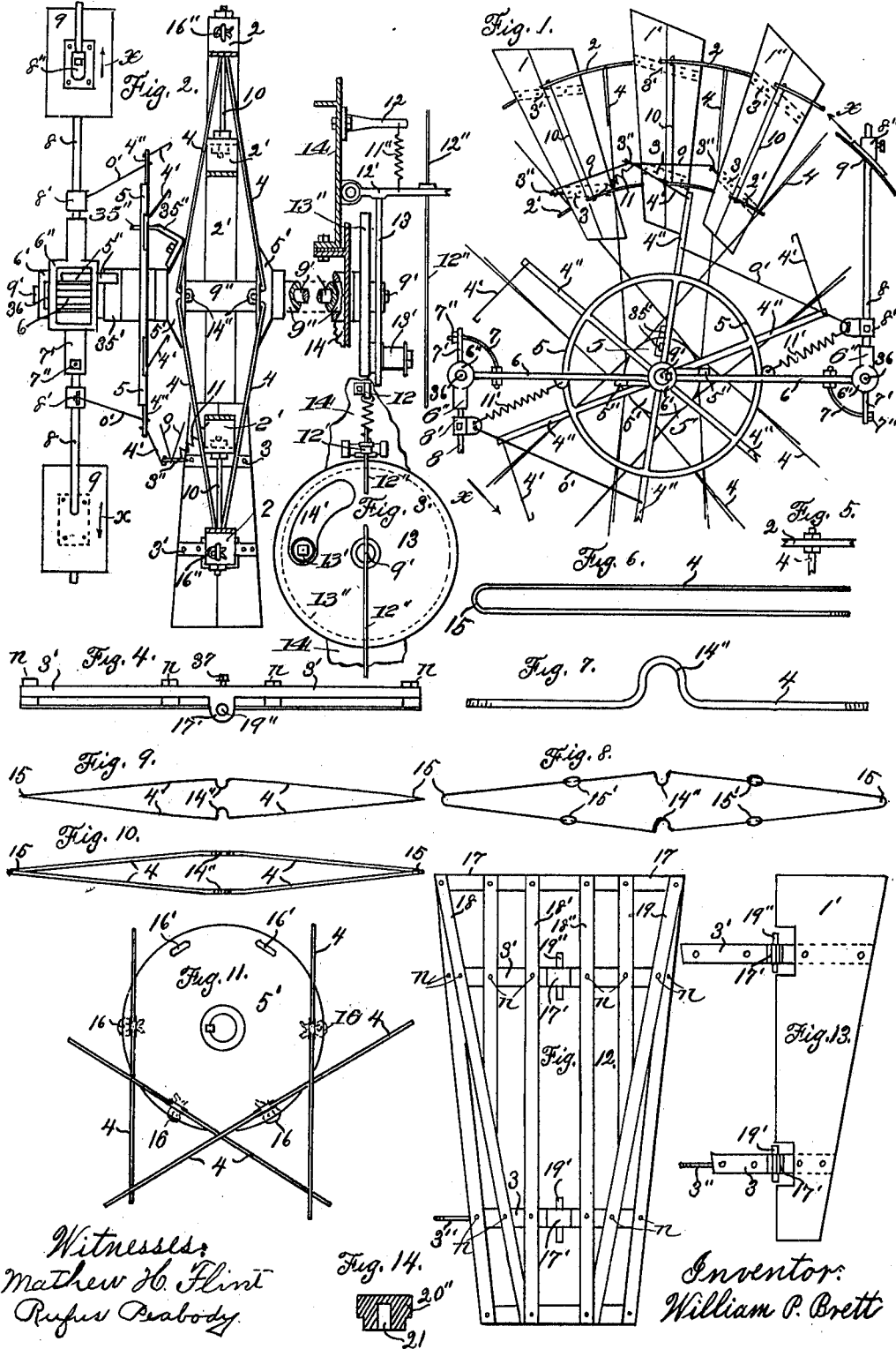


W. P. BRETT.
WINDMILL.
APPLICATION FILED FEB. 26, 1906.

980,172.

Patented Dec. 27 1910.

2 SHEETS-SHEET 1.



Witnesses:
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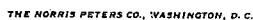
Fig. 14.
20"
21

Inventor:
William P. Brett

WINDMILL.

Patented Dec. 27, 1910.

2 SHEETS-SHEET 2.



UNITED STATES PATENT OFFICE.

WILLIAM P. BRETT, OF DECATUR, ILLINOIS.

WINDMILL.

980,172.

Specification of Letters Patent.

Patented Dec. 27, 1910.

Application filed February 26, 1906. Serial No. 303,012.

To all whom it may concern:

Be it known that I, WILLIAM P. BRETT, a citizen of the United States, residing at Decatur, in the county of Macon and State of Illinois, have invented certain new and useful Improvements in Windmills, of which the following is a specification.

This invention relates to improvements in the class commonly known as the upright or vertical wheel windmill; and the objects of this invention are, first, to provide a wind-wheel that will be light in weight, sensitive in its governing qualities, and conveniently arranged for assembling in working order and for knocking down and crating in small space for storage and shipment; second, to provide details of construction that in the main features are suitable to all sizes of windwheels; third, to provide a wheel frame or spider in which the spokes are secured to the hub and rim in such manner that there will be no tendency of their working loose during the operation of the wheel; and fourth, to provide a wheel frame of the tension spoke type that is suitable for either the feathering blade, or the solid type of windwheel. I attain these objects by the novel details in the construction, arrangement and operation of the several parts of the mechanism which will be apparent from the detailed description hereinafter when read in connection with the accompanying drawings forming part thereof, and wherein preferable embodiments of the invention are disclosed and various disconnected parts shown for the purpose of illustration.

In the drawings Figure 1, is a front view of the wheel and governor with parts broken away; Fig. 2, is a side view of the governor and a portion of the wheel; this figure also shows the crank disk, brake wheel, and means for controlling the speed of the wheel and of putting the same into and out of action; Fig. 3, is a side view of the brake wheel 13 of Fig. 2; and the controlling mechanism of the windmill, showing how said mechanism is anchored to the adjacent portion of the main frame or turntable of the windmill; Fig. 4, is an edge view of the cross bar 3' of Fig. 12; Fig. 5 is an edge view of a portion of rim 2 of Figs. 1 and 2 and shows one method of connecting the spoke 4 to the rim 2; Figs. 6, 7, 8, 9 and 10 are views showing some of the various forms

into which the spokes 4 may be made before being assembled in the wheel; Fig. 11, is a view of one of the hub portions 5' of Figs. 1 and 2; Fig. 12, is a view of the skeleton or frame of a feathering sail for the larger sizes of wheels; Fig. 13, is a view of one half of a feathering sail for the smaller and medium sizes of wheels, and also shows the cross bars 3 and 3' by means of which the two halves of the sail are secured together; Fig. 14, is a sectional view of the antifriction bushing, 20'' of Fig. 16, for the sail pivots in the large wheels; Fig. 15, is an edge view of sail 1' of Figs. 1, 2 and 13 showing the pivot adjusting stay or distance rods 10 and portions of the rims 2 and 2'; Fig. 16, is a view of a portion of the rim 2 of Figs. 1 and 2 showing how the antifriction bush 20'' is secured to the rims 2 and 2'; Fig. 17, is a view of a portion of a modified form of hub showing how the spokes 4 may be attached thereto; Fig. 18, is a front view of the skeleton or spider portion of this invention showing how it may be made and assembled for the solid type of windwheels; Fig. 19, is a view of a portion of the rim 22 of Fig. 18 showing how the sails may be secured thereto; Fig. 20, is an enlarged view of one of the sails comprising the two parts 24 and 24' shown in Figs. 18, 19, 20, 30 and 31; Fig. 21, is a view of a modified form of four integral spokes; Figs. 22, and 23 are enlarged views of the suspension wires 25 of Fig. 18; Fig. 24, is a view of a modified form of spoke showing how individual spokes may be made and secured to the rim and hub of the wheel without the use of bolts and nuts; Fig. 25, is a view of a modified form of the inner ends of the sails that may be assembled in connection with the construction shown in Fig. 18; Fig. 26, is a view of a modified form of one of the sections of the inner rim 22' of Fig. 18; Fig. 27, is an enlarged side view of the hub 26 of Fig. 18 and also shows a portion of each of the rims 22 and 22'; Fig. 28, is a view of a portion of hub 26 of Figs. 18 and 27 showing the position of the lugs 27 and 29'; Fig. 29, is a view of a modified form of a portion of a rim that may be substituted for rim 22 of Fig. 18 showing how the spoke 4 of Fig. 24 may be secured thereto, 35 indicating the end of the spoke projecting through the rim; Figs. 30 and 31 are views of the two sections of a sail as

shown in Figs. 18 and 20; Fig. 32, is a view of the inner side of the special washer or clamping piece 31 of Fig. 17; Fig. 33 is an end view of another modified form of hub; and Fig. 34 is a side view of the hub shown in Fig. 33.

Similar letters and figures refer to similar and corresponding parts throughout the several views.

In Figs. 1 and 2, 2 and 2' are the outer and inner rims of a feathering blade wind-wheel, the outer rim 2 being anchored to the hub portions 5' by means of the spokes 4, and the inner rim 2' is suspended substantially concentric with the outer rim by means of the stay or distance rods 10 preferably one on each side of each of the sails. The three blades or sails 1, 1', and 1' comprise a section of sails, each of which is pivotally anchored to said rims and all are adapted to be governingly actuated by one arm 4'' of the governor part 5 which is carried by the wheel shaft 9'' and is adapted to rotate therewith and to oscillate independent thereof. The three sails of the section are connected together by the links 0, which are secured to the projections 3'' of the cross bars 3 of the sails and are adapted to be actuated in unison by means of the link or bar 4' which is preferably connected with the center sail of the section at one end and to the end of arm 4'' at the other end; and thus any number of sections of sails may be actuated by means of a corresponding number of arms 4'' which are substantially equally spaced about and radiate from the governor part 5; thus it is readily seen that the windwheel may comprise any desired number of sail sections and that each section may comprise any desired number of sails, and also that all of the parts of each section are duplicates of and interchangeable with the corresponding parts of all of the other sections of the wheel. The governor comprises the central or hub portion 6' (see Figs. 1 and 2) which is rigidly secured to the shaft 9'' which has its bearing in the tubular wheel shaft 9'' and is adapted to oscillate therein and rotate therewith. The hub or central portion 6' carries the two arms 6 which are adapted to have the parts 6'' pivoted to the outer ends thereof, and part 6'' of each arm carries a rod or extension 8 on which are adjustably fixed the weighted governor sails 9 and the clips 8'; the curved rod 7 provided with the stop nut 7'' at its outer end passes through an aperture in the extension 7' of each of the parts 6'' and is adapted in conjunction with springs 11 and 11' and the intervening connecting parts 4', 4'', 0', and 8' to normally hold the sail carrying extensions 8 substantially at rightangles to the arms 6; the spring 11 being attached at one end to the wheel rim 2' and at the other end to the

cross bar 3, shown in broken lines in Fig. 1 and solid lines in Fig. 2, preferably of the center sail of each of the sail sections of the wheel, thus normally holding the wheel sails full in the wind and the governor sails so as to pass edgewise through the air as they revolve with the wheel, with the wheel and governor sails in these positions one of the spokes of the part 5 bears against the stop 35'' which is made rigid with the hub part 5', and the arms 6 of the governor bear against the stops 5'' which are carried by the part 35' which is rigidly secured to the shaft 9'', the part or spider 5 being free to oscillate on shaft 9'' between part 35' and the hub 5' and the part 6' with the arms 6 being carried by the oscillating shaft 9' it is readily seen that the entire governor mechanism is yieldingly held against stops 5'' and 35'' by the springs 11 and 11' during the operation of the wheel in winds that are not strong enough to cause the governor to act, but if a strong gust of wind should strike the wheel and suddenly increase the speed thereof the inertia of the governor mechanism will instantly act in overcoming the tension of the springs 11 and cause the sails 1, 1', and 1' to turn sufficiently out of the wind to effect the gradual speeding up of the wheel until the velocity is attained that will cause the governor sails 9 with their attachment weights 8'' and arms 8 to swing outward on pivots 36 by centrifugal force, and as sails 9 swing outward they present an increasing air resisting surface against which the air acts and supplements the centrifugal force in governingly actuating the wheel sails, and with the sails 9 partially extended in a good operating wind there is established an operating condition of the governor under which it is very sensitive in its governing qualities by reason of the harmonious action of the centrifugal and centripetal forces of the arms 8, sails 9 and sail attachment weights 8'' and the resistance of the air thereagainst and the momentum and inertia of the entire governing mechanism which in a good strong wind will cause the wheel to rotate at an approximately uniform and unvarying speed regardless of wind and load variations in connection with which the wheel is adapted to operate.

The broken part 14 (see Fig. 2) represents a portion of the windmill turntable which carries the shaft 9'', the main part of the bearing for the shaft 9'' being shown as broken away and 13'' is the crank disk which is secured to the inner end of the wheel shaft 9'', the part 13 is a brake wheel formed as shown in Fig. 3 and is rigidly secured to the inner end of the governor shaft 9' and is adapted to oscillate therewith, with the wristpin 13' extending through the aperture 14', and in connection with the brake 12', the

spring 11'', and the pull cord 12'' constitutes a means by which the windwheel may be optionally controlled by a person at a distance therefrom by means of the cord 12'' which may be made to extend to any desired position; this optional controlling of the wheel is accomplished by pulling downward on the cord 12'' which sets the brake 12' on the wheel 13 holding it against rotation to the extent of causing the governor mechanism, above described, to overcome the tension of springs 11 and turn the sails to their inactive position, the forward movement of the wheel effecting this result when the brake 12' is applied to the wheel 13, but when the cord 12'' is not drawn downward the spring 11'', which is attached at its upper end to the bracket 12 will normally hold the brake free of the wheel 13 and the springs 11 will hold the wheel sails in their active positions. The slot 14' in the brake wheel 13 through which the wrist-pin 13' extends is of such length as to permit the brake wheel to oscillate independent of the crank-disk to the extent that when the wrist-pin 13' bears against the metal of the brake wheel at one end of the slot the wheel sails will be held full in the wind and when the wrist-pin bears at the other end of the slot the sails will be held full out of the wind and when the wind-wheel is in operation with the brake 12' free of the wheel 13 the governor will cause the shaft 9' and wheel 13 to oscillate so that the wrist-pin 13' may not bear against either limit of the slot 14' but the brake wheel may be continuously making short oscillations relative to the crank-shaft and disk; the position of the wrist-pin in the slot being determined by the relative conditions of the load carried by the wheel and the force of the wind by which the wheel is being impelled.

Great strength is required in windwheels for heavy work and it is important that all of the material used in their construction should be distributed to the best advantage possible and in order to accomplish this I provide a rigid central or hub portion as shown in either of Figs. 1, 2, 11, 18, 27, 28, 33, and 34, all of which are adapted to be assembled in working order with any of the spokes shown in these drawings excepting the form shown in Fig. 21 which requires the special construction of hub attachment shown in Figs. 17 and 32.

Figs. 9 and 10 show two groups each of which comprises four spokes made of one endless wire or rod, the spokes in Figs. 1, 2 and 11 being of the form shown in Fig. 9 and the spokes shown in connection with Figs. 18, 27, 28, 33 and 34 are of the form shown in Fig. 10, and in all of these figures each spoke is indicated by the reference figure 4; Fig. 11 is an enlarged view of one of the hub flanges 5' of the wheel shown in

Figs. 1 and 2 as seen when looking in the direction of the length of the wheel shaft; in these figures the flanges stand substantially at right angles to the wheel shaft and are provided with the oblong apertures 16' through which the loops 14'' of the spokes are adapted to be forced and secured therein by means of a pin or key as shown at 16 in Fig. 11. The spokes shown in Fig. 9 when spread as shown in Fig. 10 are in shape to be assembled in connection with either of the hubs shown in Figs. 27 and 34 and in each of these hubs the loop 14'' stands substantially at right angles to the wheel shaft instead of parallel therewith as shown in Figs. 1, 2, and 11.

In Figs. 18, 27 and 28 the loops 14'' are designed to be clamped between the flanges 26' and 27' (see Fig. 27) and embraced by the two lugs 27, of one of the flanges, as shown in Fig. 28 with the bolt 27'' extending through the loop and flanges, thus securing the spokes rigidly to the hub. The hub shown in Figs. 33 and 34 is a pulley shaped cylinder or shell 28 and is provided with a series of oblong apertures near each edge portion of the rim substantially as shown at 16' in Fig. 34 and the loops 14'' of the spokes are adapted to be inserted and secured with a split key substantially as shown at 16 in Fig. 34, thus it is apparent that the spokes shown in Figs. 9 and 10 are adapted to be attached to the hubs and outer rims of the wheels either as shown in Figs. 1, 2, and 11 or as shown in Figs. 18, 27, and 34, and as the rim 2 (see Figs. 1 and 2) is secured to the spokes of the wheel by means of keys substantially as shown at 16'' in Figs. 2 and 19 it is also shown that all of the spokes have substantially uniform size and strength throughout and that there is no possible chance for loosening at any point or breakage of any of the spokes in a properly proportioned wheel, and that wheels of this type of construction may be made exceedingly light in weight and of great strength.

In the two types of wheel shown in Figs. 2 and 18 the outer rim of each type is connected with the hub of the wheel by as many spokes as may be necessary, considering the work to be accomplished by the wheel, and is prevented from bulging out between the spoke attachments by means of the stay or distance rods 10 in the type shown in Figs. 1 and 2, and by the tension wires 25 in the type shown in Fig. 18, and the inner rim in each type is preferably anchored to these rods or wires exclusive of any anchorage to either the spokes or hub of the wheel. Means for varying the distance between the outer and inner rims and maintaining a fixed distance there-between, in line with the sail pivots, in the type shown in Figs. 1 and 2 is provided in the running thread and nuts on the rods 10 substantially as

shown in Fig. 15, thus providing means for accurate adjustment to the sail pivots as well as giving extra strength and any desired uniform tension to all parts of the wind wheel. In the type shown in Fig. 18 the tension wires 25 are made with a suitable loop somewhat as shown at 36' and 36'' in Figs. 22 and 23 and are secured to the outer rim by means of a key the same as the spokes are attached thereto; the inner rim in this type of wheel may consist of a number of sections of round rods formed in any suitable shape but preferably somewhat as shown in Fig. 26 and are provided with right and left threads adapting them to be secured in operative position substantially as shown in Fig. 18 by means of the turnbuckles 22'' and these sections may be slightly crimped as shown in Fig. 26 so as to equally space the inner ends of the sails and the tension wires 25. For the solid type of wheel the sails are preferably provided with a clip or anchorage flange as 32' shown in Figs. 19 and 20 or they may be anchored to the outer rim and held at the proper angle to the wind by means of the braces 32'' and 33 shown in Fig. 19 also, and the inner ends of the sails are provided with either the aperture 33' or the eye 23' as shown in Figs. 20 and 25. The inner rim 22' see Fig. 18 is put through the eyes or loops 36'' (see Figs. 22 and 23) of the tension wires 25 one section at a time and then secured together by means of the turnbuckles 22'', and the sails may be secured to the outer rim, which is preferably composed of detachable sections secured together as shown at 34' in any convenient and substantial manner but preferably in the usual way by means of a bolt or rivet through the rim and clip 32' as shown at 34'' in Fig. 19 for the sails that are located between the tension rods 25 and for the sails that are located adjacent to these rods and the spokes the same key that secures the wires and spokes may be made to also secure the sails as shown at 16'' in Fig. 19. The wire 34 is attached to the outer rim and twisted into the turnbuckles after they have been adjusted and are simply to prevent the turnbuckles from twisting so as to maintain the tautness of the inner rim 22'. Before securing the wires 34' and after assembling and adjusting all of the other parts of the wheel any desired tension may be given to the spokes and uniformly to all tension parts of the wheel by so turning the turnbuckles 22'' as to contract the inner band 22' thus causing the outer band or rim to tend to bulge outwardly at the points of wind-spoke attachments. In this type of wind-wheel it is preferable to so proportion the sails that the surface outside of the rim 22 is approximately the same in area as the portion that extends inwardly so that the

rim 22 carries substantially the entire load of the wheel, and with the sails thus balanced on the outer rim the inner ends may be secured so as to prevent any impairing vibration of the sails by means of the coiled extension springs 25' which are simply hooked into the aperture 33'' at one end and into one of the crimps 23 (see Fig. 26) of the inner rim 22', the springs 25' being under such tension as to maintain the proper spacing and steadiness of the sails, thus it is readily seen that with this yielding connection for the inner ends of the sails a substantially uniform stress is exerted upon all of the sails regardless of what the working strains of the wheel may be, and that substantially the same construction of wheel frame or spider is adapted to use in connection with either the feathering blade or solid wheel type.

In the smaller sizes of solid wheels the inner rim 22' may pass through the eyes 23' or aperture 33' substantially as shown in Fig. 25 without throwing any undue strains on any of the sails thus cheapening the construction of the wheels.

Instead of the construction of sails shown in Figs. 1, 2 and 13 the sails of the feathering blade type for the large wheels are preferably provided with a skeleton or frame work comprising longitudinal slats 18, 18' and 18'' and 19 and end slats 17 and 17' made in two parts detachably secured together by means of cross bars as shown at 3 and 3' in Figs. 4 and 12 in which n indicates detachable screws which pass through the cross bars 3 and 3' and are screwed into the longitudinal slats thus detachably securing the two parts, into one rigid sail frame. 17' is an apertured enlargement in the bars 3 and 3' and is adapted to receive the pivot pins 19' and 19'' which are adjustably secured therein by means of the setscrews 37 (see Figs. 4 and 15), and in the medium and smaller sizes of wheels the pivot pins 19' and 19'' may have their bearings in apertures through the rims of the wheel as shown in Fig. 15 but for the large wheels it is preferable to provide an antifriction bushing or removable bearing as 20'' shown in Figs. 14 and 16 which may be made of oil soaked wood or any other antifriction material, and these bearings are secured in place on the inside of the rim 2 and on the outside of the rim 2' by means of the clips 20 which are held in place by bolts 20', and the aperture 21 in the bush does not extend entirely therethrough thus providing an end thrust bearing for each of the pins 19' and 19'' which can in connection therewith be so adjusted as to take up all lost motion and thus cause silent running of the wheel; these antifriction bearings and the light frames of the sails with canvas or other light weight sail material in connection therewith make

possible the construction of a very strong, light and easy running feathering blade windwheel, which in connection with the governing mechanism above described is

5 very sensitive in its governing qualities.

The method of pivoting the sails at their outer ends as is usually done throws all of the wind pressure on bearings that are extremely wide apart which causes the sails to
10 spring and cause undue strains and friction on the sail pivots, thus causing rapid wear of the pivots and very seriously interfering with the governing of the speed of the wheel. To overcome these objectionable features I
15 place the pivots at such distance from the ends of the sails as to give a sail surface outside of the pivots that is substantially equal to the surface between the pivots so that the wind pressure is practically balanced on the pivots with but slight tendency
20 to spring the sails, with the further advantage of having the pivots closer together, thus giving greater strength to resist the tendency to spring under the heavier wind pressures; I also place these pivots in the longitudinal
25 centerline of the sail with the longitudinal centerline of the pivots in the plane of the sail surfaces. With the sails thus nicely poised upon the pivots there is but little
30 force required to governingly actuate them thus making it possible to govern the speed of the wheel very closely.

In the very large wheels the spokes 4 may be made in detachable parts as shown in
35 Figs. 6 and 7 and connected together in operative form by means of the turnbuckles 15' as shown in Fig. 8, and if at any time it may be found convenient or desirable to have but two instead of four united it is readily
40 done by simply making the spokes in the form shown in Fig. 7 of a length suitable to the size of the wheel and secure the ends thereof to the rim of the wheel as shown in Fig. 5.

Fig. 21 represents a group of four spokes made integral from two pieces of wire or rods preferably by means of the electric
45 welding process, the enlargements 30 midway between the bends or loops 15 are caused by the process of welding and are purposely made unusually large so as to provide a
50 substantial means of attachment to the hub of the wheel, this attachment of the spokes to the hub of the wheel is made substantially as shown in Figs. 17 and 32 in which 31'
55 is a portion of the wheel hub and 31 is a special clamping piece or washer which is provided, on its clamping side, with the groove 30'' and the cavity 30' for securing
60 the spokes in place, a corresponding groove and cavity being formed in the coacting part of the hub which is also provided with an aperture or cavity for the reception of the lug 31' which assists in holding the clamping
65 piece 31 immovable when the nut is

tightened on the bolt 27'' with the spoke in place between the hub and clamping piece as shown in Fig. 17, the enlargement 30 being made for a tight fit in the cavity 30' thus
70 providing a very rigid and enduring means of attachment of the spokes to the hub of the wheel.

Having thus described my invention and the manner of its operation, what I claim as new and desire to secure by Letters Patent
75 is—

1. The combination in a windwheel of an outer rim, an inner rim, a hub for said windwheel, spokes connecting said hub and outer rim, a plurality of sails each of which
80 is pivoted substantially on its longitudinal center line and intermediate its end portions to both of said rims, a stay or distance rod connecting said rims adjacent to each of said sails and independent of the pivot portions
85 thereof, and mechanism adapted to automatically oscillate said sails for regulating the speed of the windwheel.

2. The combination in a windwheel of an outer rim, an inner rim, a hub, spokes
90 connecting said hub and outer rim, a plurality of sails each of which is pivoted substantially on its longitudinal center line and intermediate its end portions to both of said rims, and a stay or distance rod extending
95 from one to the other of said rims adjacent to each of said sails and independent of the pivot portions thereof.

3. The combination in a windwheel of an outer rim, an inner rim, a hub, spokes
100 connecting said hub and outer rim, a plurality of sails each of which is adapted to oscillate about its longitudinal center line which radiates from the central portion of said windwheel, and an adjustable spacing
105 or distance rod in connection with said rims near to and independent of the pivot portions of each of the said sails.

4. The combination in a windwheel of an outer rim, an inner rim, stay or distance
110 rods connecting said rims, a hub, spokes connecting said hub and outer rim, a plurality of skeletons or frames each comprising longitudinal and cross bars for carrying the sail surface portions of the wind-
115 wheel, and means whereby the said skeletons or frames may be pivotally secured to said rims.

5. The combination in a windwheel of an outer rim, an inner rim, stay or distance
120 rods connecting said rims, a hub, spokes connecting said hub and outer rim, a plurality of longitudinally divided two part sails, means whereby the two parts of each sail may be detachably secured together, and ad-
125 justable pivot portions whereby said sails are adapted to oscillate about radial axes.

6. The combination in a windwheel of an outer and an inner rim, a plurality of
130 sails each of which is adapted to oscillate

about a radial axis, a pair of cross bars for each of said sails, and an adjustable pivot pin for each of said cross bars.

7. The combination in a windwheel of an outer and an inner rim, two part sails separable longitudinally, a plurality of cross bars for each of said sails, adapted to detachably secure the parts thereof together, and adjustable pivot pins for said cross bars.

8. The combination in a windwheel of an outer rim, an inner rim, stay or distance rods connecting said rims, a hub, spokes connecting said hub and outer rim, a plurality of skeletons or frames for carrying the sail surface portions of the windwheel, and pivot bars whereby said skeletons or frames are adapted to be pivotally anchored to said rims.

9. The combination in a windwheel of an outer and an inner rim, a plurality of pivoted sails each of which is adapted to oscillate about a radial axis in the plane of said rims, and removable bearing portions carried by said sails and comprising parts of said sail pivots.

10. The combination in a windwheel of an outer and an inner rim, bearings arranged in pairs with one of each pair secured to each of said rims, a sail for each of the said pairs of bearings, and adjustable pivot parts carried by said sails and adapted to an operative engagement with said bearings.

11. The combination in a windwheel of an outer and an inner rim, removable thrust bearings arranged in pairs with one of each pair secured to the inside of the outer rim and the other to the outside of the inner rim, and a sail for, and adapted to be pivotally anchored to each of the said pairs of bearings.

12. The combination in a windwheel of an outer rim, an inner rim, stay or distance rods connecting said rims, a plurality of bearing portions arranged in pairs the bearings of each pair being substantially in the same radial line and one carried by each of said rims, a plurality of skeletons or frames for carrying the sail surface portions of the windwheel and made to extend both ways beyond the bearings in the direction of the radial lines thereof and each adapted to be pivotally anchored to any one of the said pairs of bearings.

13. The combination in a windwheel of an outer and an inner rim, a plurality of groups of sails each group comprising a plurality of sails each of which is provided with a pivot bearing in connection with each of said rims, a governor part adapted to rotate with and to oscillate independent of said windwheel, an actuating bar or link connecting each of said groups of sails with said governor part, pivoted levers mounted independent of said governor part, and means whereby said levers may be automati-

cally caused to impart an oscillatory motion to said governor part with respect to said windwheel during its rotation.

14. The combination in a windwheel of a plurality of groups of sails, a plurality of sails in each of said groups each of which is adapted to oscillate about a radial axis, a governor part adapted to rotate with and to oscillate independent of said windwheel, a link connection between said governor part and each of said groups of sails, pivoted levers mounted independent of said governor part, and means whereby said levers may be automatically caused to impart an oscillatory movement to said governor part with respect to said windwheel during its rotation.

15. The combination in a windwheel of a plurality of groups of sails, a plurality of sails in each of said groups adapted to oscillate about radial axes in turning to and from the wind, a governor part adapted to rotate with and to oscillate independent of said windwheel, means whereby said groups of sails may be actuated by said governor part, pivoted levers mounted independent of said governor part, and means whereby said levers may be caused to impart an oscillatory motion to said governor part with respect to said windwheel during its rotation therewith.

16. The combination in a windwheel of a plurality of oscillatory radially fixed sails, a governor part adapted to rotate with and to oscillate independent of said windwheel, means whereby said governor part is adapted to cause the oscillation of said sails, pivoted levers mounted independent of said governor part, and means whereby said levers may cause the oscillation of said governor part with respect to said windwheel during its rotation.

17. The combination in a windwheel of a plurality of oscillatory radially fixed sails, a governor part carrying a governor sail and adapted to rotate with and to oscillate independent of said windwheel, and means whereby said governor part and sail are adapted to automatically cause the oscillation of said radially fixed sails during the operation of said windwheel.

18. The combination in a windwheel of an outer rim, an inner rim, detachable bearings or sail attachment parts for said rims, a hub, spokes attached to said hub and outer rim, means whereby said inner rim is maintained approximately concentric with and at the sail attachment parts at a fixed distance from said outer rim independent of any supporting attachment with said hub spokes or sails, and the said windwheel sails anchored to said outer and inner rims.

19. The combination in a windwheel of an outer rim, a hub or central portion comprising axially spaced means for spoke at-

5 attachments, two sets or series of spokes axially separated at said hub or central portion and connecting the same with said outer rim, an inner rim approximately concentric with said outer rim and embraced between said two sets of spokes, sails radially fixed and anchored to said rims, and means independent of said spokes and sails for maintaining said rims at a fixed distance apart.

10 20. The combination in a windwheel of an outer rim, a hub or central portion comprising axially spaced means for spoke attachments, two sets or series of spokes axially separated at said hub or central portion and connecting the same with said rim, an inner rim approximately concentric with said outer rim and embraced between said two sets of spokes, sails approximately radially fixed and anchored to said rims, and means independent of said sails whereby the portions of said rims in the radial lines of said sail anchorages are held at fixed distances apart during permissible working fluctuations in distance between other portions of said rims.

25 21. The combination in a windwheel of an outer rim, a hub or central portion, spokes connecting said hub and outer rim, an inner rim, sails substantially radially fixed and anchored to both of said rims, and means independent of said sails and spokes whereby the portions of said rims that are in the lines of the anchorages of said sails are held at fixed distances apart during permissible working fluctuations in distance between other parts of said rims.

30 22. The combination in a windwheel of an outer rim, a hub or central portion, spokes connecting said central portion and rim, an inner rim, sails anchored to said rims, and means whereby said inner rim is rigidly fixed in its position and exclusively suspended from said outer rim independent of any rigid connection with either the hub, spokes or sails of the windwheel.

35 23. The combination in a windwheel of an outer rim, a hub, spokes connecting said hub and rim, an inner rim, sails anchored to said rims, detachable antifriction rail bearings secured to said rims and means for maintaining the portion of said rims at their points of attachment to said sails at fixed distances apart independent of any direct attachment to either the spokes or hub of the windwheel.

40 24. The combination in a windwheel of a hub comprising axially spaced spoke attachment parts, a rim provided with spoke attachment parts, an endless rod comprising four integral spokes provided with hub and rim attachment parts, and means whereby the said hub and rim attachment parts of the said spokes may be secured to their respective spoke attachment parts of the said hub and rim.

45 25. The combination in a windwheel of a

hub or central portion provided with axially spaced spoke attachment parts, a rim provided with spoke attachment parts, an endless rod comprising four spokes provided with hub and rim attachment parts made integral therewith, and means for securing the hub and rim attachment parts of the said spokes to their respective parts of the said hub and rim. 70

26. The combination in a windwheel of a hub or central portion comprising axially spaced spoke attachment parts, an endless rod so formed as to constitute four spokes provided with hub and rim attachment parts made integral therewith, a rim for said windwheel, and means for detachably securing said spokes to the said rim and hub. 75 80

27. The combination in a windwheel of a hub or central portion comprising axially spaced means for spoke attachments, groups of spokes each group comprising four spokes made integrally, bent parts constituting the hub and rim attachment portions of said spokes, means whereby said bent parts may be securely attached to said hub and rim respectively, and means whereby any desired tension may be given to said spokes. 85 90

28. The combination in a windwheel of a hub provided with axially spaced spoke attachment parts, an endless rod so formed as to constitute four spokes, U shaped bends at the extremities of said spokes so formed that each bend constitutes a means for the securement of two of the said spokes at their respective points of attachment, a rim provided with spoke attachment parts, and keys for securing said U shaped bends to their respective parts of said hub and rim. 95 100

29. The combination in a windwheel of a hub or central portion provided with axially spaced means for spoke attachments, a rim, spokes provided with U shaped bends which constitute the hub and rim attachment portions thereof, spaced apertures through said rim and other apertures through parts of said hub, and keys whereby said U shaped bends are secured in said rim and hub apertures respectively. 105 110

30. The combination in a windwheel of a hub provided with axially spaced spoke attachment parts, a rim for said windwheel, a plurality of oblong apertures through each of the said spoke attachment parts and said rim, an endless rod so formed as to constitute four spokes the said rod having loop portions integral therewith which are adapted to extend through the respective oblong apertures in the said spoke attachment parts and rim, and a key for securing each loop portion as set forth. 115 120 125

31. The combination in a windwheel of a hub or central portion provided with axially spaced means for spoke attachments, a rim provided with oblong apertures, spokes provided with bends or loops for rim attachment. 130

ment portions, means whereby said spokes may be secured to said hub or central portion, and keys for securing said loops or bends in said oblong apertures for the purpose set forth.

32. The combination in a windmill of a wheel frame or spider, a plurality of sails carried by said frame and adapted to oscillate about radial axes, a governor device adapted to rotate with and to oscillate independent of said frame or spider, a governor part adapted to rotate with and to oscillate independent of both said device and frame or spider, a link connection between said governor part and said sails, pivoted levers carried by said governor device, and a link connection between said pivoted levers and said governor part.

33. The combination in a windwheel of a wheel frame or spider, a plurality of sails carried by said frame and adapted to oscillate about radial axes, a governor device carrying air resistible sails and adapted to rotate with and to oscillate independent of said frame or spider, and means whereby said governor device and air resistible sails may automatically cause the oscillation of all of the said plurality of sails during the rotation thereof with said wheel frame or spider.

34. The combination in a windmill of a wheel frame or spider, a plurality of wheel sails carried by said frame and adapted to oscillate about radial axes, a governor device adapted to rotate with and to oscillate independent of said frame or spider, a tubular shaft carrying said frame or spider, a governor shaft carrying said governor device and extending through said tubular shaft, a brake wheel carried by said governor shaft, a brake normally free of said brake wheel and adapted to be so actuated as to resist the rotation thereof, and means whereby said governor device may automatically cause the oscillation of said wheel sails during the rotation of said frame or spider.

35. The combination in a windmill of a rotatable motor part carrying a plurality of radially fixed oscillatory sails, a governor device adapted to rotate with and to oscillate independent of said motor part and carrying air resistible sails, and means whereby said air resistible sails may automatically cause the oscillation of said radially fixed sails during the rotation of said motor part.

36. The combination in a windmill of a rotatable motor part carrying a plurality of radially fixed oscillatory sails, a governor device adapted to rotate with said motor part, weighted governor sails carried by said device, and means whereby said governor sails may automatically cause the oscillation

of said radially fixed sails during the rotation of said motor part.

37. The combination in a windmill of a rotatable motor part carrying a plurality of radially fixed oscillatory sails, a governor device adapted to rotate with said motor part, pivoted levers carried by said governor device, governor sails carried by said pivoted levers, and means in operative connection therewith whereby said governor sails and pivoted levers may automatically cause the oscillation of said radially fixed sails during the rotation of said motor part, substantially as and for the purpose set forth.

38. The combination in a windmill of a rotatable motor part carrying a plurality of radially fixed oscillatory sails, a governor device adapted to rotate with and to oscillate independent of said motor part, pivoted levers carried by said governor device, governor sails carried by said pivoted levers, and means in connection therewith whereby the resistance of the air acting substantially at right angles to the direction of the force of the wind will cause the said governor sails, levers and governor device to governingly actuate the said radially fixed oscillatory sails during the rotation of the said motor part.

39. The combination in a windmill of a tubular rotatable motor part carrying a plurality of oscillatory sail portions which are adapted to active and inactive positions, a governor shaft extending through and adapted to oscillate relative to the said motor part, a governor device mounted in connection with one end of said governor shaft and a brake member mounted in connection with the other end, means carried by said governor device and motor part for governingly actuating said sail portions, and means whereby said brake member may be caused to hold the said governor device and motor part against rotation.

40. The combination in a windwheel of a tubular rotatable motor part, a plurality of windwheel sails pivotally mounted and carried by said motor part, a main frame comprising the bearing portion for said tubular motor part, a governor shaft extending through the said tubular motor part, a governor operatively mounted in connection with the said governor shaft and said windwheel sails, an air resistible sail portion carried by and constituting a part of said governor, and controlling mechanism mounted in connection with said main frame and said governor shaft.

41. The combination in a windmill of a tubular rotatable motor part, a plurality of pivotally mounted sail portions carried by and adapted to actuate the said motor part, a main frame part comprising the bearing portion for said motor part, a governor shaft

extending through said tubular motor part, a governor mounted in connection with the outer end of the said governor shaft and the said pivotally mounted sail portions, governing members adapted to be actuated by the resistance of the air and centrifugal force for causing the said governor and shaft to oscillate independent of the said motor part, and controller devices mounted in connection with the said main frame part and the inner end of the said governor shaft for the purpose set forth.

42. The combination in a windmill of a windwheel hub, an outer rim, an inner rim, detachable antifriction sail bearing portions, spokes secured to said hub and outer rim, a plurality of sails anchored to said rims, and a stay or distance rod connecting said rims adjacent to each of said sails but independent of the anchorage portions of the sails.

43. The combination in a windwheel of an outer rim, an inner rim, stay or distance rods connecting said rims, a plurality of frames for carrying the surface portions of the windwheel sails, a hub and spokes, and means whereby said frames are adapted to be pivotally anchored to said rims.

44. The combination in a windmill of a rotatable motor part carrying pivotally mounted motor sail portions, a governor device mounted to rotate with and adapted to oscillate independent of the said motor part, a plurality of arms extending outwardly from the central part of said device, a connecting link or bar extending from each of said arms to their respective parts of said motor sail portions, another governor part adapted to rotate and to oscillate with said governor device, arms extending oppositely from the central portion of said governor

part, a swinging lever pivoted to the outer portion of each of said oppositely extending arms and adapted to, normally, stand substantially at right angles to the said oppositely extending arms, an adjustable governor sail and weight carried by each of said swinging levers, and a connecting link or bar extending from each of said swinging levers to said governor device.

45. The combination in a windmill of a rotatable motor part carrying motor sails which are adapted to active and inactive positions, a governor part mounted to rotate with and adapted to oscillate independent of said motor part, a plurality of pivoted levers carried by said governor part and adapted to be caused to swing outwardly, by centrifugal force, as they rotate, means adapted to hold said levers yieldingly against the action of said centrifugal force, governor weights and sails carried by said levers, and means whereby the said pivoted levers and governor weights and sails may automatically cause said motor sails to oscillate to and from the wind during the rotation of the said rotatable motor part.

46. The combination in a windwheel of a rotatable hub portion provided with axially spaced apertured spoke attachment parts, a rim having apertured spoke attachment parts, spokes provided with loops for hub and rim attachments, and keys adapted to secure said loops in the said apertures of said hub and rim attachment parts respectively.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM P. BRETT.

Witnesses:

SAMUEL R. GHER,
SOPHIA McVITTY.