No. 640,901. Patented Jan. 9, 1900.

R. E. HARDAWAY.

WIND AND WATER MOTOR.

(Application filed Mar. 5, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

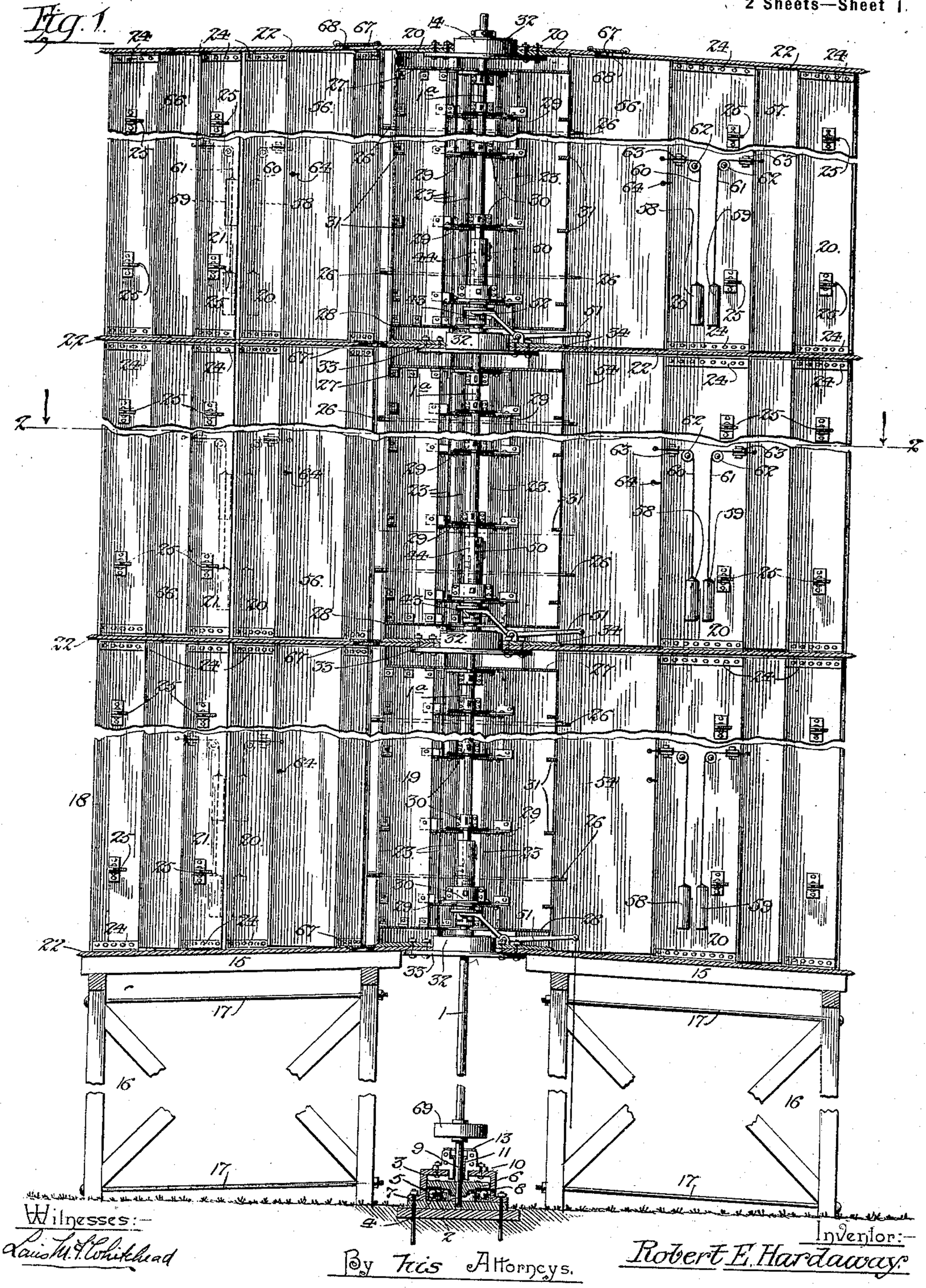

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Fig. 2.

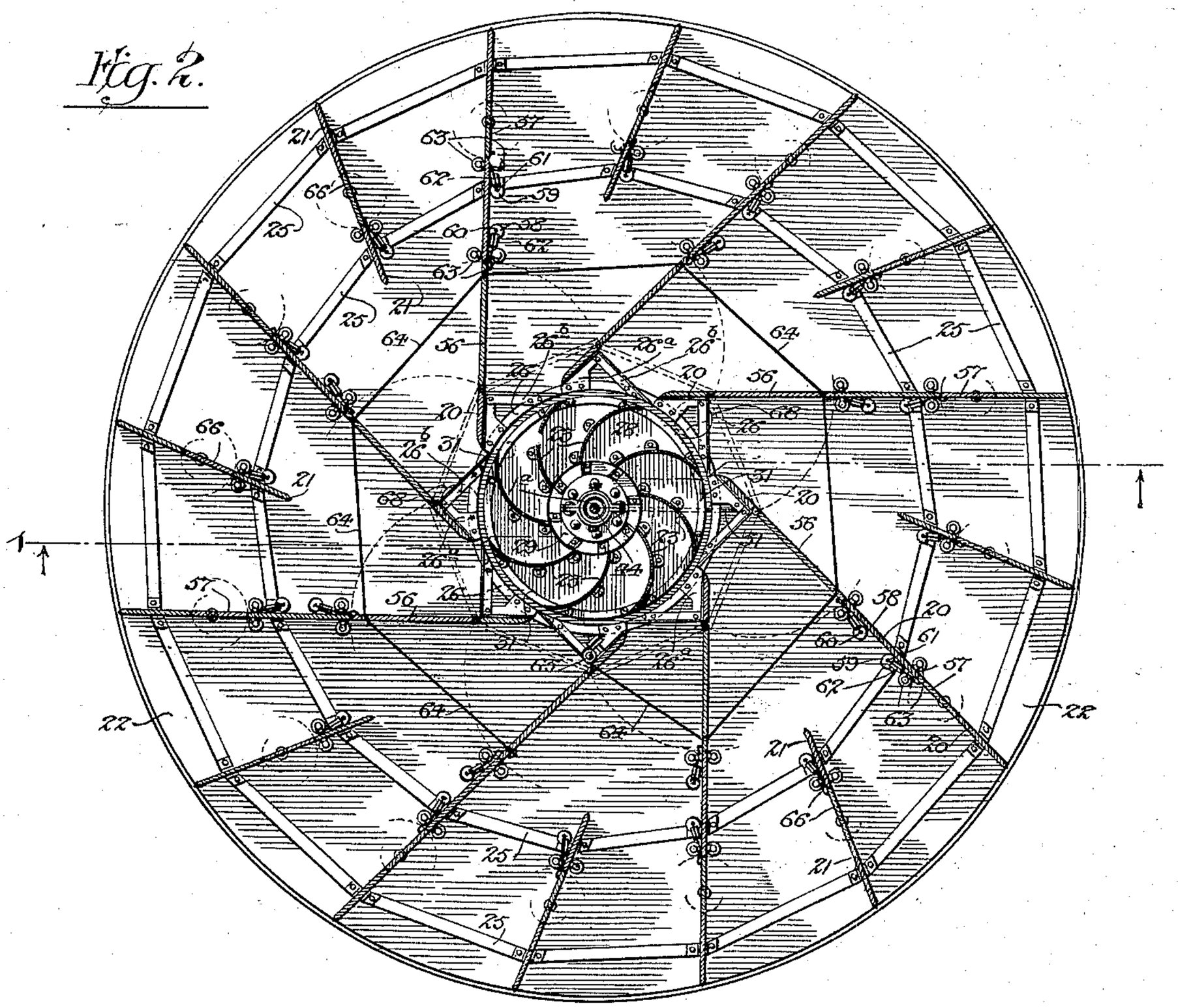


Fig. 3.

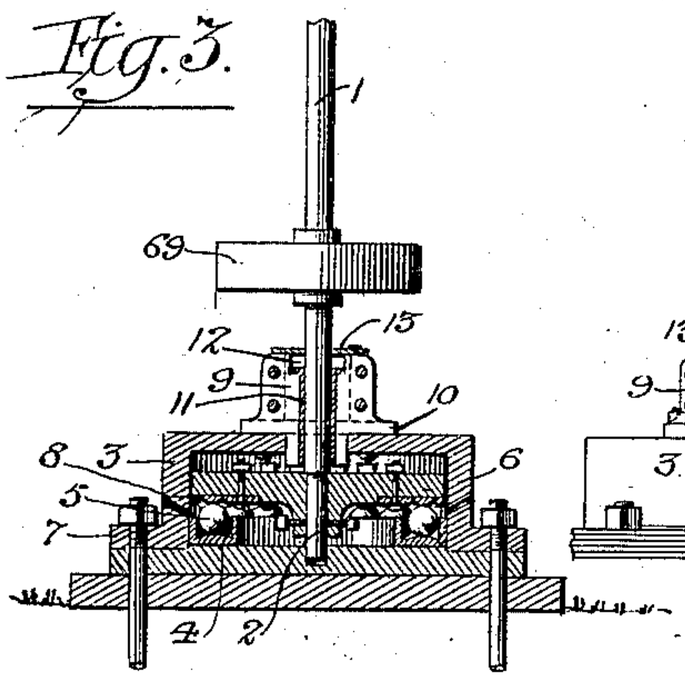


Fig. 5.

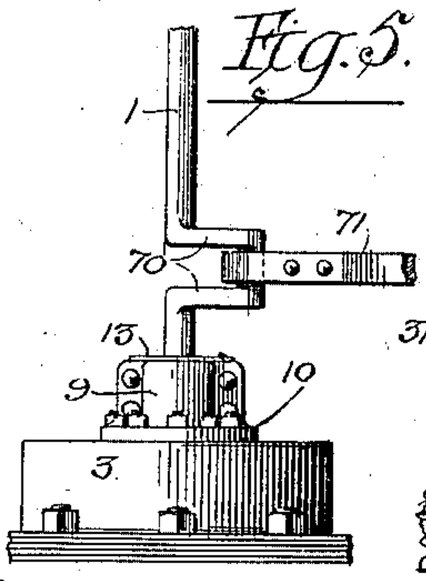
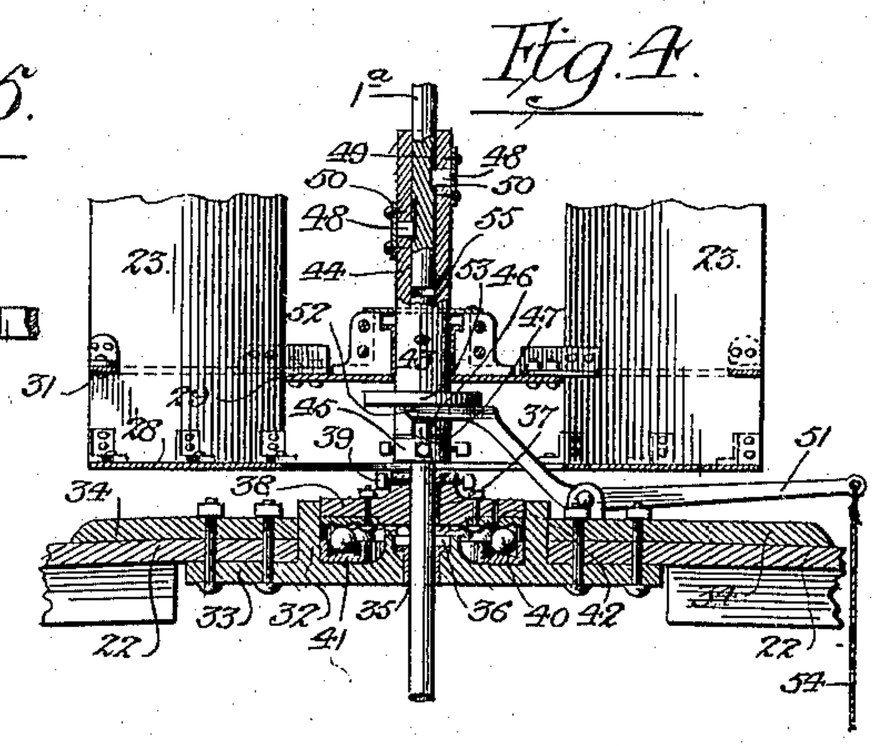


Fig. 4.



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UNITED STATES PATENT OFFICE.

ROBERT EARLY HARDAWAY, OF AUSTIN, TEXAS.

WIND AND WATER MOTOR.

SPECIFICATION forming part of Letters Patent No. 640,901, dated January 9, 1900.

Application filed March 5, 1898. Serial No. 672,677. (No model.)

To all whom it may concern:

Be it known that I, ROBERT EARLY HARDAWAY, a citizen of the United States, residing at Austin, in the county of Travis and State of Texas, have invented a new and useful Wind and Water Motor, of which the following is a specification.

The invention relates to improvements in wind and water motors.

The object of the present invention is to improve the construction of windmills, more especially that shown and described in Letters Patent No. 588,572, granted to me August 24, 1897, and to increase the efficiency and durability of the same and lessen the cost of construction.

Another object of the invention is to provide a construction which besides being adapted to be operated by the wind will be capable of use in tidal rivers, streams, and other currents.

The invention consists in the construction and novel combination and arrangement of parts, as hereinafter fully described, illustrated in the accompanying drawings, and pointed out in the claims hereto appended.

In the drawings, Figure 1 is a vertical sectional view of a windmill constructed in accordance with this invention. Fig. 2 is a horizontal sectional view on the line 2 2 of Fig. 1. Fig. 3 is an enlarged detail sectional view of the lower bearing of the wind-wheel shaft. Fig. 4 is an enlarged detail view illustrating the construction of one of the intermediate bearings of the wind-wheel shaft and illustrating the construction for throwing the wind-wheels in and out of gear. Fig. 5 is a detail view showing the wind-wheel shaft provided with a crank.

Like numerals of reference designate corresponding parts in the several figures of the drawings.

1 designates a vertical wind-wheel shaft having its lower end 2 stepped in a bearing-casing 3, provided with a circular ball race or channel 4, receiving a series of antifriction-balls 5, which support a bearing-disk 6. The bearing-casing 3 consists of a horizontal bottom plate provided with a central socket to receive the lower end 2 of the wind-wheel shaft, a horizontal top plate, and vertical side walls, and the said casing is provided with an outwardly-extending horizontal flange 7, which is perforated for the reception of suitable fastening devices for securing the bearing-casing 3 in position.

The lower end 2 of the wind-wheel shaft is reduced to receive the bearing-disk 6, which fits against the shoulder formed by such reduction and is adapted to support the lower end of the wind-wheel shaft above the bottom of the central socket of the bearing-casing 3. The annular ball-race 4 of the bearing-casing 3 may be constructed in any suitable manner and consists of vertical walls and a convex bottom, and the bearing-disk 6 is provided at its lower face with a convex ring 8, secured in a recess of the disk 6 and forming a bearing-surface for the tops of the balls. The casing 3 is provided at one side with an oil-hole located above the annular ball-race and adapted to permit the same to be readily supplied with oil.

The wind-wheel shaft, which may taper from top to bottom, passes through a bearing-sleeve 9, located at the top of the casing 3 and extending downward through a central opening of the same and provided with a horizontal flange 10, which is bolted or otherwise secured to the top of the bearing-casing 3. The sleeve 10, which forms a journal-box, is composed of two sections detachably secured together, and a lining 11, of brass or other suitable metal, is arranged within the sleeve 9. By constructing the bearing-sleeve in two sections it may be readily removed for renewal, repair, or adjustment. The top of the bearing-sleeve is provided with an oil-recess 12 and has a cover or lid 13 for the same. The cover may be hinged or it may be pivoted and arranged to rotate horizontally to open and close it.

The upper end of the wind-wheel shaft is journaled in a bearing 14 of a casing mounted on a frame consisting of a platform 15 and a supporting-framework 16, suitably trussed and braced by rods 17.

The casing 18, which receives and surrounds a wind-wheel 19, is mounted upon the platform of the supporting-frame and consists of vertical partitions 20 and 21, diverging outwardly and composed of sections connected

by horizontal partitions 22, the top horizontal partitions forming a roof and being sloped or inclined downward from the center. The horizontal partitions 22 divide the casing into a series of stories or compartments, and a vertical series of wind-wheels is employed. The vertical series of horizontal wind-wheels, which are provided with legs 23, correspond to the compartments or stories of the casing, and the wind-wheels of the series are coupled together detachably, by means hereinafter described, in order that one or more of the wind-wheels may be operated at a time, according to the amount of power required. The vertical and horizontal partitions are connected together by L-shaped plates or knees 24, the flanges of which are suitably secured to the partitions, and the vertical partitions are supported at intervals between the horizontal partitions by horizontal tie-bars 25, secured to the vertical partitions by L-shaped plates or knees and extending around the casing and forming annular braces, as clearly shown in Fig. 1 of the accompanying drawings. One or more annular series of braces may be employed, according to the size of the windmill.

The vertical partitions, which converge toward the vertical series of wind-wheels, are disposed substantially tangential with relation to the same, and they are adapted to constrict and compress the air gradually as it approaches the wind-wheels, and thereby increase the force of the wind and enable considerable power to be obtained from a comparatively light wind. They enable the casing to receive the wind from any quarter, and while they concentrate the force of the wind at one side of the wind-wheels they serve as shields to protect the other side of the same and prevent the blades from being retarded as they come into the wind.

The vertical partitions 21, which are narrower than the partitions 20, divide the spaces between the latter, and the wider partitions 20 extend from the outer periphery of the horizontal partitions to inner circular braces 26, which are composed of semicircular sections arranged in pairs to form a complete ring and secured to the vertical partitions 20 by L-shaped plates or knees 26^a and 26^b.

The blades of each wind-wheel correspond in length to the height of the compartment or stories of the casing, and they are connected to the sections of the wind-wheel shaft by horizontal disks or plates 27 and 29 and to each other by bottom plates 28, which have a central opening substantially equal to the diameters of the plates or disks 29. The plates 27, which are arranged at the top of the wind-wheel sections, extend entirely across the ends of the sections from the outer edges of the blades to the wind-wheel shaft, and the intermediate plates extend from the inner edges of the blades to the wind-wheel shaft and are located at points intermediate of the ends of the blades, being secured to the wind-wheel shaft by flanged collars 30, bolted to the plates or disks, and fastened to the wind-wheel shaft by keys, clamping-screws, or other suitable fastening devices. The top plates are also secured to the wind-wheel shaft by collars 30, and the plates 27 and 28 are designed to be arranged to run as close as possible to the non-revolving or fixed parts above and below them. The blades are supported at their outer edges at points opposite the intermediate plates 29 by annular braces 31, consisting of semicircular bars arranged in pairs in slots of the plates and secured to the latter by L-shaped knees or plates. The curve of the blades 23 preferably consists of an arc of ninety degrees; but any other preferred curve may be employed. The curve shown, however, is deemed the most advantageous, as it has been found to produce a maximum power, and the wind exerts a pressure on the blades both in entering and leaving the wind-wheel. The inner and outer edges of the vertical partitions and the outer edges of the horizontal partitions are beveled, as shown, to avoid retarding the wind. The outer edges are oppositely beveled in order to afford no obstruction to air passing to either side of them, and the inner edges of the vertical partitions are provided with a single long bevel.

The wind-wheel shaft is supported at the top and at intermediate points by bearings consisting of a bearing-casing 32, provided with a central opening to receive the vertical shaft 1, and having outwardly-extending horizontal flanges 33, which are bolted or otherwise secured to the horizontal partitions 22 at the top and bottom of the compartments of the casing, the partitions 22 being strengthened by annular reinforcing-plates 34, arranged around the bearing-casing 32 and provided with a central opening to receive the same. The central opening 35 of the bearing-casing is lined with brass or other suitable metal, and an oil-recess 36 is arranged at the top of the central opening 35, oil being fed to the recess 36 through an oil hole or passage 37 of a convex bearing disk or plate 38. The bearing disk or plate 38, which is constructed similar to the bearing disk or plate 8 of the bottom bearing, is secured to the shaft 1 by clamping-screws 39 or other suitable fastening devices, and is supported upon an annular series of antifriction-balls 40, arranged in an annular channel or race 41, similar to that heretofore described. The bearing-disk or plate 38 is provided at its lower face with a bearing-ring 42 to engage the tops of the balls, and the bearing is supplied with oil by means of an oil-hole extending through the bearing disk or plate 38 and the bearing-ring 42.

Each wind-wheel is mounted on a section 1^a of the wind-wheel shaft, and sections of the wind-wheel shaft are coupled together by a clutch 43, composed of upper and lower sec-

tions 44 and 45 and provided at their adjacent ends with interlocking lugs or flanges 46 and 47. The lower section 45 of the clutch is fixed to the upper end of one of the sections of the wind-wheel shaft by clamping-screws or other suitable fastening devices, and the upper or sliding section 44 of the clutch is connected with its section of the wind-wheel shaft by keys 48, arranged in slots of the sliding clutch-section and engaging grooves 49 of the wind-wheel shaft, and the said keys, which are detachably secured within the slots by plates 50, are located at different elevations in order to avoid the weakening effect which would result from arranging the slots and the grooves at the same point.

The clutch is operated by a lever 51, fulcrumed between its ends in a suitable bearing of the reinforcing-plate 34 and having its arms arranged at a slight angle to each other. The inner arm is provided with a forked portion 52, curved to conform to the configuration of the clutch-section 44 and engaging the same beneath a horizontal annular flange 53. The outer end of the lever is connected by a rope or cable 54 with a windlass or other suitable device for enabling the clutch to be operated from the base of the windmill in an engineer's room or the like. The rope or cable 54 passes through perforations of the horizontal partitions of the casing, the shifting-lever being of sufficient length to locate the rope or cable 54 beyond the blades of the wind-wheel, and by means of the clutches one or more of the wind-wheels may be used at a time, according to the amount of power desired from the windmill.

The sections of the wind-wheel shaft are supported slightly out of contact with each other, as illustrated in Fig. 4 of the accompanying drawings, and the sliding section 44 of the clutch is provided with an oil-hole 55, communicating with a space between the sections of the wind-wheel shaft.

The vertical partitions 20 of the casing of the windmill are provided with inner and outer horizontal swinging doors 56 and 57, which are controlled and held normally closed by weights 58 and 59, attached to the lower ends of cords 60 and 61 or other flexible connections, which pass over suitable guide-pulleys and which are connected at their upper terminals to the adjacent edges of the doors. Each cord passes over a vertical guide-pulley 62 and is arranged between a pair of horizontal guide-pulleys 63, located at opposite sides of the partition and adapted to receive the cord when the door opens in either direction. Should the pressure of the air exceed the power of the weights, the doors will be automatically opened to reduce the pressure, and by regulating the weights any normal power of the windmill may be obtained.

The inner doors are hinged at their inner vertical edges, and when it is desired to exclude air entirely from the wind-wheel the doors are swung transversely of the spaces between the partitions to the position illustrated in dotted lines in Fig. 2 of the accompanying drawings by means of an operating wire or cable 64, connected at one end to one of the inner doors, near the free edge thereof, at a point below the pulleys and extending horizontally around the outer edges of all of the other swinging doors, which are preferably provided with perforations having metallic linings. These doors may also be provided, if desired, with pulleys for the operating wire or cable 64. The wire or cable after passing through the perforations of the inner doors extends inward over guide-pulleys 65, and downward at a point just inside of the annular series of doors to the base of the windmill, to be connected with a windlass or other suitable device for swinging the doors across the spaces between the vertical partitions, so that they will exclude wind from the wind-wheel. The doors are locked in this position by the pawl of the windlass, and as soon as the operating cable or wire 64 is slackened the weights of the doors will return the latter to their normal position and expose the wind-wheel to the wind to start the windmill. The operating wires or cables are designed to be arranged so that one or more of the wind-wheels may be exposed to the wind, and by means of the operating wires or cables and the clutches of the wind-wheel shaft the wind-wheel may be readily adjusted to suit the character of the machine to be operated by it.

The narrow vertical partitions 21 may be provided with doors 66, similar to the outer doors 57 of the vertical partitions 20; but these doors 57 and 66 may be employed or omitted, as desired.

The casing and the supporting-frame may be constructed of any suitable material, such as wood and metal, and, if desired, canvas or other heavy fabric or analogous material may be used in constructing the vertical and horizontal partitions, metal framing being designed to be used with such material. For greater strength the horizontal and vertical studding between planks and the windmill may also be provided with a steep roof, with a space to operate the machine at the top of the shaft under the roof.

Small windmills may be placed on the tops of dwellings and buildings for household service and ornament in the shape of an observatory. For small windmills simpler and cheaper fastenings and bearings may be used, as cleats and nails, and for economy in the first cost ball-bearings may be omitted, ring-bearings being used to carry the weight of the wheel. The proportions of the wind-wheel and the casing may be varied according to the cost of the material employed and to the character of the winds at the place where the windmill is to be erected, local material being preferably employed in the construction of the windmill.

The lower section of the wind-wheel shaft carries a pulley 69, adapted to receive a belt,

by means of which motion may be readily transmitted to any ordinary machinery; but, as illustrated in Fig. 5 of the accompanying drawings, a crank 70 and pitman 71 may be employed. Also instead of arranging the crank at a point between the ends of the wind-wheel shaft it may be readily located at the lower end, and an eccentric or any other form of gearing may be employed for transmitting motion from the wind-wheel shaft to the devices to be operated.

The invention has the following advantages: The windmill, which is strong and durable, may be constructed with any number of stories or sections of the casing and the wind-wheel, and as the wind-wheels are detachably coupled together and the inner doors of the various stories or compartments of the casing are independently operated one or more wind-wheels may be used at a time, and the windmill is thereby readily adapted to afford any power within its capacity, and is capable of being readily adjusted to suit the character of the machinery to be operated and the work to be done. The mill may be partly or entirely submerged in a current of a tidal river or any other stream, and when so employed the gearing for transmitting motion from the wheel to the machinery to be operated will be arranged to suit the disposition of the mill.

The construction of the wheel and casing shown and described is adapted for use in water, and when so employed the bottom or lowermost floor of the casing will be securely bolted or otherwise secured to rock or pile foundation. The machine to be operated by the motor will be located above the latter in a room or building arranged above high-water mark.

Changes in the form, proportion, and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of this invention.

What I claim is—

1. In a device of the class described, the combination of a vertical series of wheels, a casing surrounding the wheels and comprising vertical partitions extending outward from the wheel, and horizontal partitions dividing the casing into stories or compartments corresponding to the wheels, a series of doors arranged in each of the stories or compartments, independently-operated clutches coupling the wheels, and means for operating each series of doors independently of the other series, whereby one or more of the wheels may be exposed to a current of wind or water, substantially as described.

2. In a device of the class described, the combination of a wheel, a casing composed of vertical partitions and horizontal partitions dividing the casing into compartments or stories, a series of doors arranged in each of the stories or compartments and adapted to swing across the spaces between the vertical partitions to shut off the wind from the wheel, and operating wires or cables passing around the wheel and connected with the free edges of the doors and adapted to swing the same across the spaces between the partitions, said wires or cables being independently operated, substantially as described.

3. In a device of the class described, the combination of a vertical series of wheels, a series of clutches connecting the wheels, each clutch being composed of a fixed member and sliding members, shifting-levers connected with the sliding members of the clutches and provided with operating wires or cables, a casing surrounding the wheels and provided with vertical partitions extending outward from the same, hinged doors mounted on the partitions and arranged to swing across the spaces between the same, means for holding the doors normally closed, and operating wires or cables connected with the doors and arranged to swing the same across the spaces between the vertical partitions, substantially as described.

4. In a motor of the class described, the combination of a vertical shaft, a horizontal wheel comprising vertical blades having their inner edges spaced from the shaft, intermediate plates extending from the shaft to the inner edges of the blades, a top plate secured to the shaft and connected with the adjacent ends of the blades, and a bottom plate connecting the lower ends of the blades and disconnected from the shaft, and a casing surrounding the wheel and having an annular series of partitions extending therefrom, substantially as described.

5. In a device of the class described, the combination of a casing having an annular series of partitions extending outward from the central portion of the casing, a vertical shaft, a vertical series of wind-wheels mounted upon the shaft and having their blades separated therefrom by an intervening space open at the bottom, and couplings located at the bottoms of the wind-wheels in the said space, and means for operating the couplings, whereby one or more wind-wheels may be used, substantially as described.

6. In a device of the class described, the combination of a vertical shaft, a vertical series of wind-wheels having annular series of blades arranged around the shaft and separated therefrom by an intervening space, couplings arranged within the said space, and means for operating the couplings whereby one or more of the wind-wheels may be used, substantially as described.

7. In a motor of the class described, the combination with the casing, of a vertical wheel-shaft consisting of a series of alined sections, a separate wheel mounted on each shaft-section, a bearing suspending each shaft-section from its upper end, clutches separably coupling together the shaft-sections, and means for operating each clutch independently of the others, substantially as set forth.

8. In a motor of the class described, the combination with the casing, of a vertical wheel-shaft consisting of a plurality of alined sections, a separate wheel mounted on each shaft-section, and a bearing suspending each shaft-section from its upper end, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

ROBERT EARLY HARDAWAY.

Witnesses:

SUTTON SELWYN SCOTT,

ROBERT ANDERSON HARDAWAY.