(Model.)

2 Sheets—Sheet 1.

J. HUMPHREY.

TURBINE WHEEL.

No. 309,227. Patented Dec. 16, 1884.

Fig. 1.

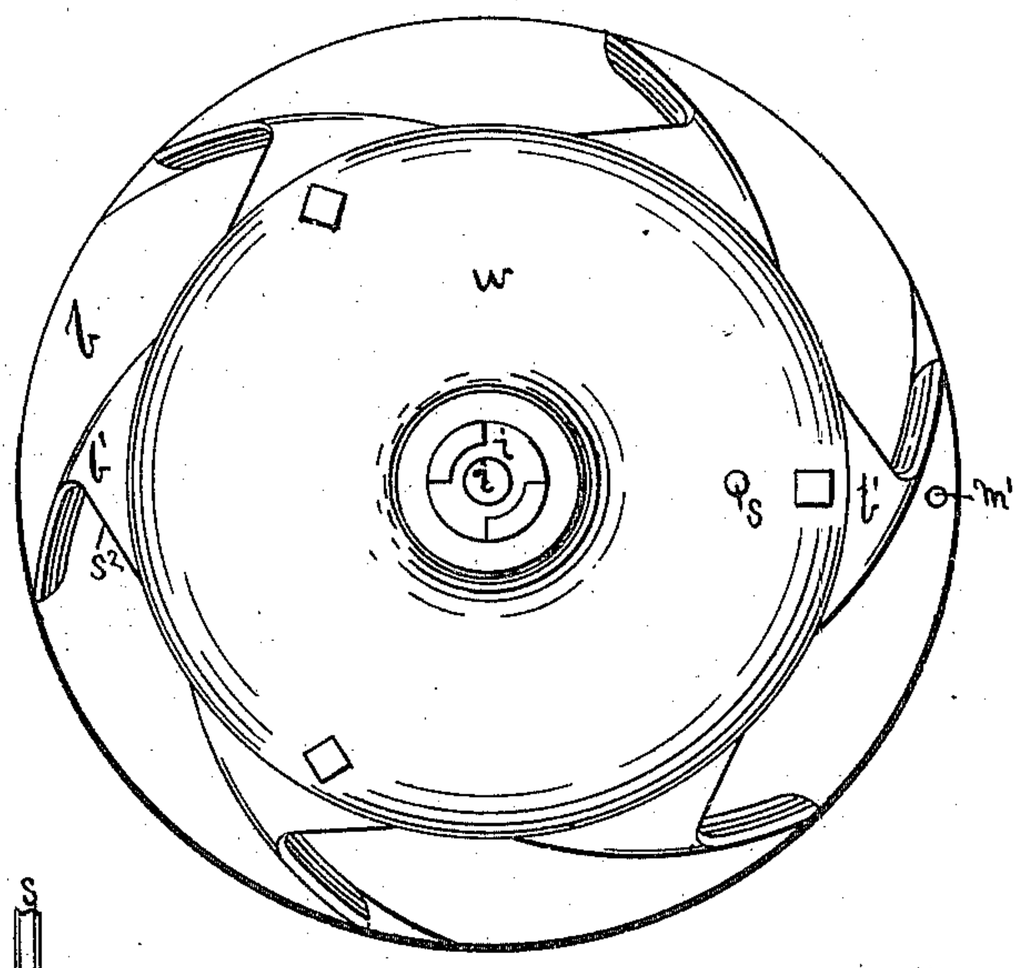
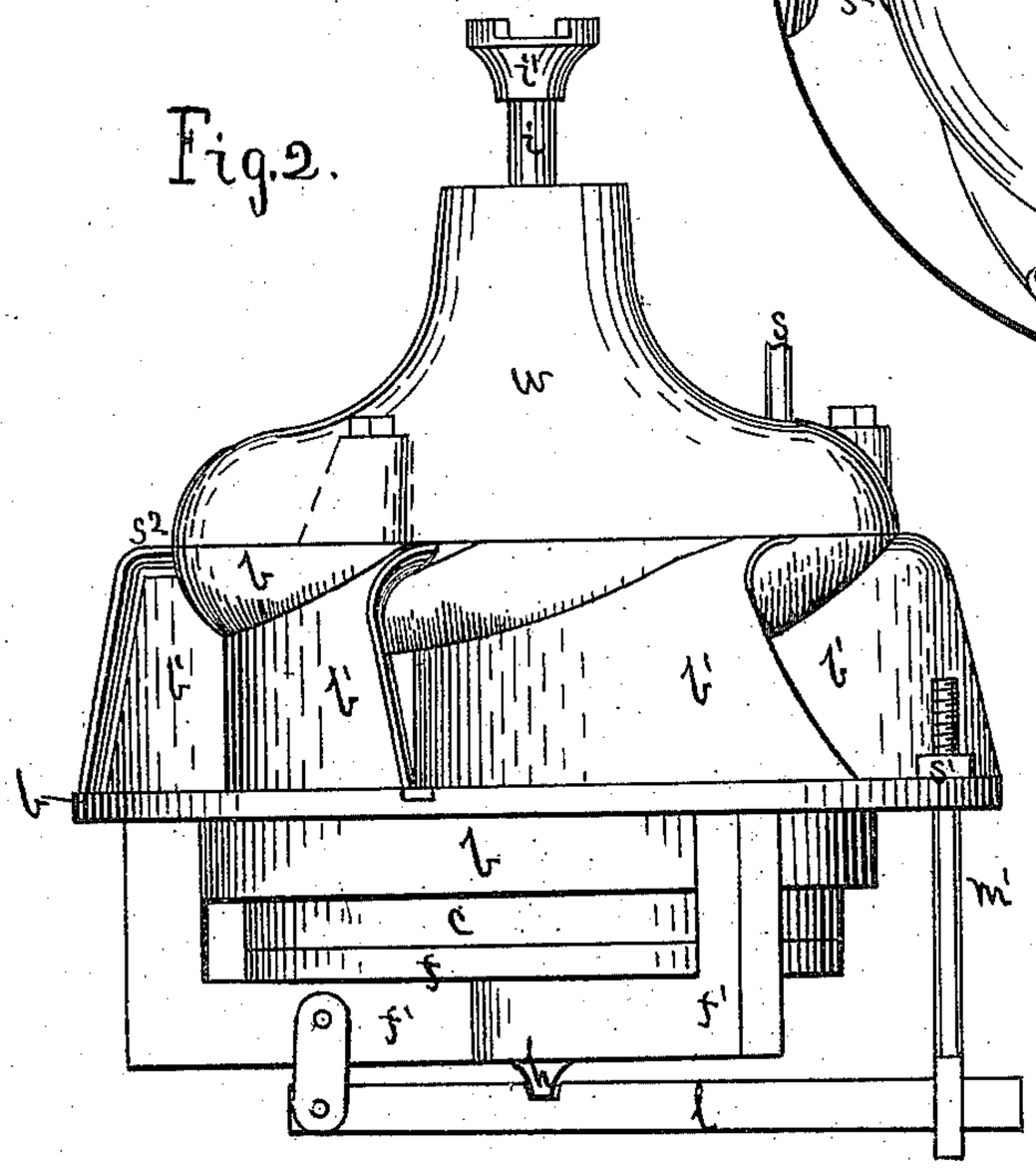


Fig. 2.



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(Model.)

2 Sheets—Sheet 2.

J. HUMPHREY.

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No. 309,227. Patented Dec. 16, 1884.

Fig. 3.

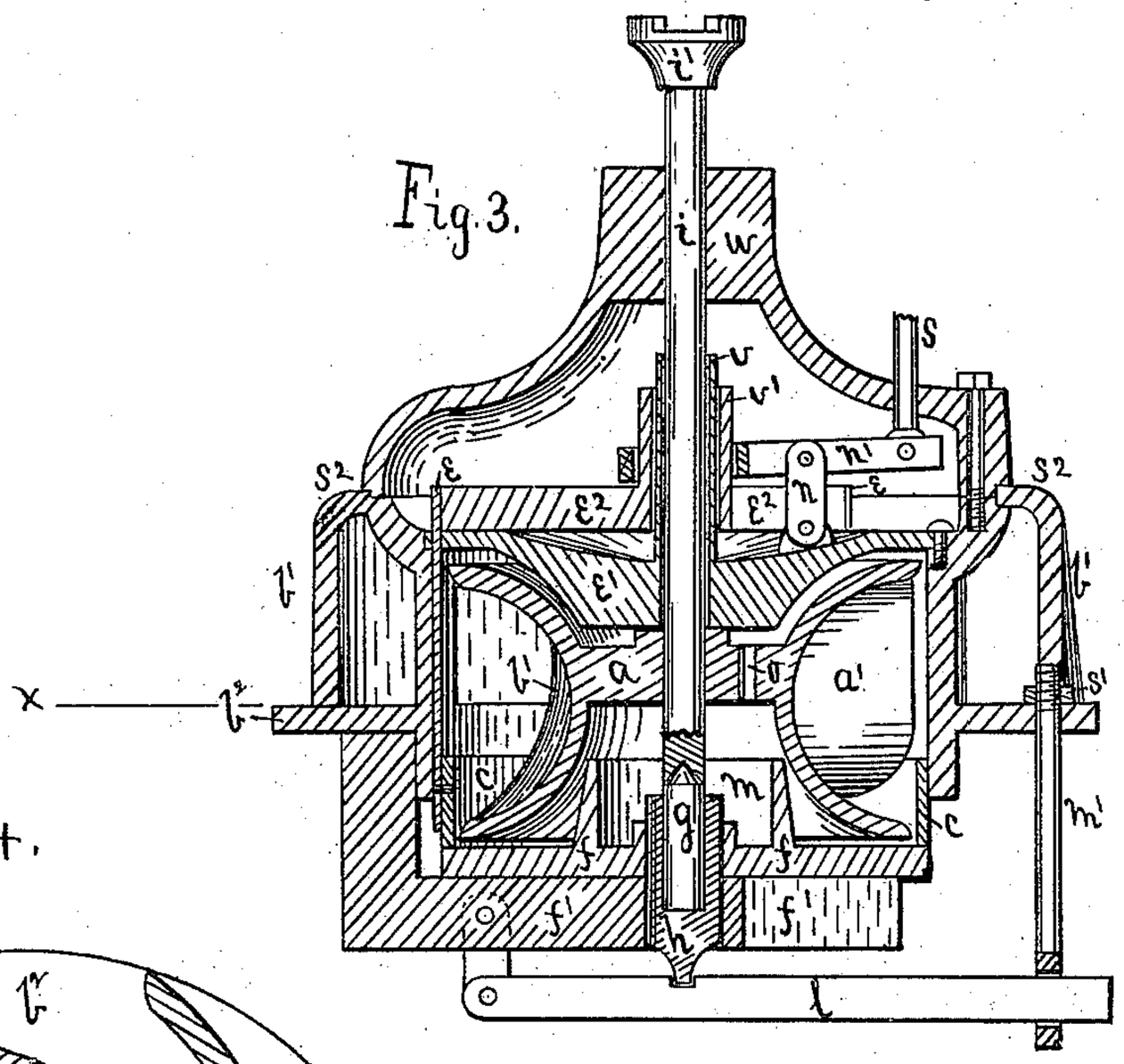


Fig. 4.

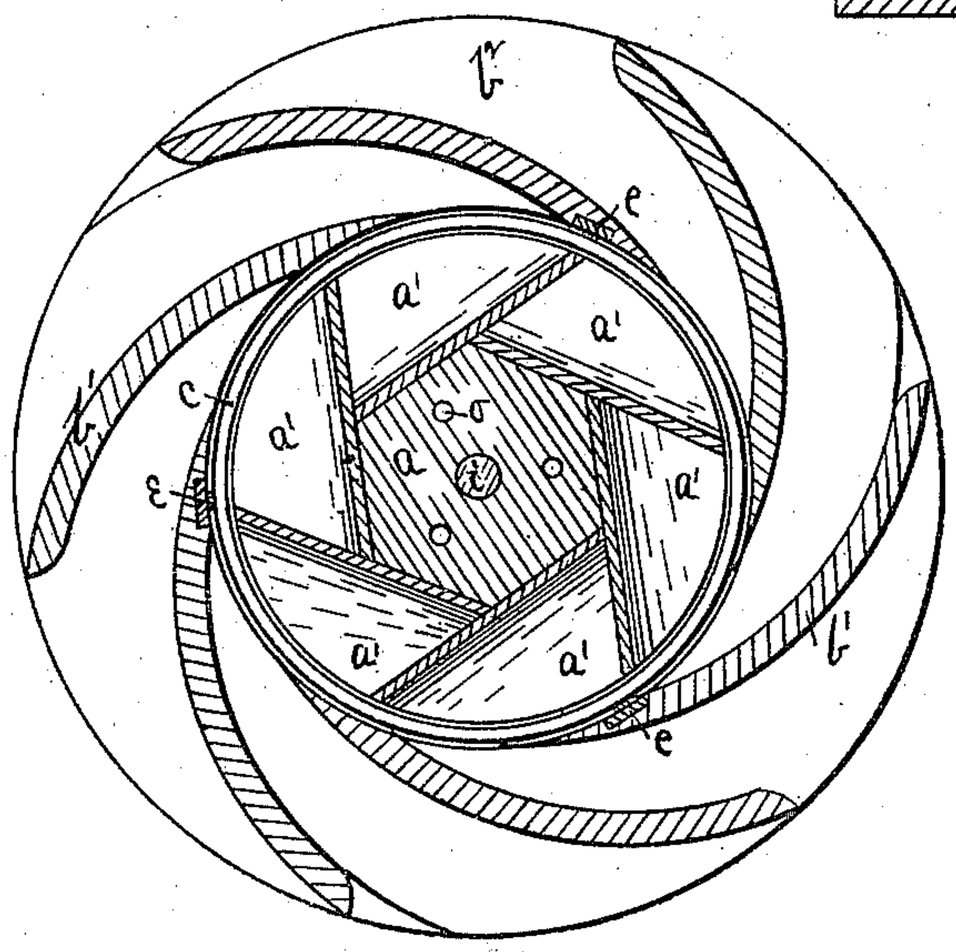
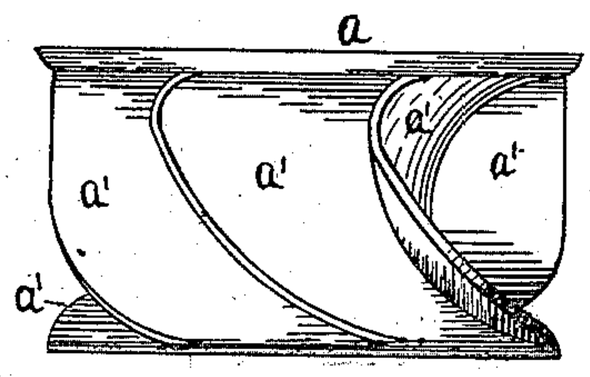


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN HUMPHREY, OF PARIS, OHIO.

TURBINE WHEEL.

SPECIFICATION forming part of Letters Patent No. 309,227, dated December 16, 1884.

Application filed April 24, 1883. (Model.)

To all whom it may concern:

Be it known that I, JOHN HUMPHREY, of Paris, Portage county, Ohio, have invented a new and useful Improvement in Turbine Wheels, of which the following is a specification.

My invention relates to cylindrical turbine wheels formed with tangential concave buckets inclined downward away from the direction of rotation and open at the circumference, into the upper part of which the water enters through curved ports in the wheel-case, and discharges outwardly at the lower part of the circumference of the wheel beneath a ring-gate surrounding the wheel.

In the drawings forming a part of this specification, Figure 1 is a plan. Fig. 2 is an elevation. Fig. 3 is a vertical section. Fig. 4 is a horizontal section at the center of the wheel at line *x* in Fig. 3; and Fig. 5 is an elevation of the wheel removed from its case.

The wheel-case is composed of an upper part or cap, *w*, and lower part, *b*, bolted together. The lower part, *b*, bridge-plate *f*, and bridge-tree *f'* may all be cast in one piece. The guides *b'* are a part of the wheel-case, and form between them curved ports to conduct the water to the upper part of the circumference of the cylindrical wheel *a*. Wheel-case *b* is formed with flange b^2 surrounding it, through which it may be bolted to the bottom of the flume in which it may be placed for use. Wheel *a* is keyed on its shaft *i*, which is formed with a cavity in its lower end to receive the conical upper end of the wooden step *g*. Above wheel *a* the shaft extends through disk *e'*, formed with a sleeve, *v*, and also through cap *w*, and has a coupling, *i'*, at the top. Step *g*, on which wheel *a*, by its shaft *i*, is supported, rests in socket *h*, whose lower end rests on lighter-bar *l*. Socket *h* slides in bridge-plate *f* and bridge-plate tree *f'*. By turning nut *s'* on rod *m'*, which supports the outer end of lighter-bar *l*, socket *h*, and step *g*, with wheel *a* and its shaft *i*, the wheel may be raised or lowered to properly adjust its position and to compensate for wear of step *g*. Bridge-plate *f* is formed with a cup, *m*, in which the upper part of step *g* is situated. The leakage of water between disk *e'* and the top of wheel *a* into the concavity in the top of the wheel falls through openings or holes *o* in the hub of the wheel into cup *m*, keeping it full of water, in which step *g* is constantly immersed, thereby preventing the friction of the rotating shaft *i* on step *g* from heating and burning the step. The overflow from cup *m* is discharged between the bottom of wheel *a* and the top of bridge-plate *f* at the circumference of the bridge-plate and wheel. The gate *c* is in the form of a ring or short cylinder surrounding the lower part of wheel *a*, and closely fitting the inner circumference of wheel-case *b*. The discharge of water from wheel *a* is regulated by raising and lowering gate *c*. The gate is operated by means of rod *s*, lever *n'*, and spider e^2, connected with the gate by supporting-bars *e e e*. The inner circumference of wheel-case *b* is grooved vertically to receive bars *e*. Spider e^2 is formed with an upward-projecting hub, *v'*, and slides on sleeve *v* of disk *e'*. Shaft *i* extends through disk *e'* and its sleeve *v* without being in contact with them. Link *n*, pivoted to disk *e'* and lever *n'*, forms the fulcrum of the lever, which is pivoted at one end to hub *v'* of spider e^2, and at the other end to rod *s*. Downward pressure on rod *s* raises gate *c*. When the pressure is removed, the weight of spider e^2 and the gate closes the latter down on the top of bridge-plate *f* at its circumference, fitting it closely to prevent the discharge of water. Rod *s* may be connected with a governor, and weighted to balance or nearly balance gate *c*. Disk *e'* is bolted to and divides the wheel-case into two compartments, the upper part inclosing devices for operating gate *c*. The circumference of the wheel-case at its greatest diameter is vertically of a semicircular form, curving out and up from the inner ends of the ports a quarter of a circle to the top of the outer ends of guides *b'*, which are bent inward at s^2, and form the upper side of the curved ports, which are thus made gradually divergent at the top from the inner end to the outer opening, and the port sides are similarly divergent by the relative arrangement of guides *b'*, to allow of free entrance of the water. Wheel *a* is cylindrical, and the outer edges of the concave buckets *a'* are in the circumference of the

wheel. These buckets are tangential to the wheel, in order to utilize the pressure of the water continuously from its entrance through the curved ports between guides *b'* and first impact against the upper sides of the buckets until its discharge from the lower edges of the buckets at the circumference of the wheel. From the fact that the water has substantially the whole circumference of the wheel for discharging itself, and also the effect on it of centrifugal force, the ring-gate *c* needs to have but little vertical movement to control the discharge.

In turbine wheels in common use the gates are applied to regulate the inflow through the ports, but with buckets *a'* formed as described, and having such position as set forth herein relative to each other and to the wheel with its case and ring-gate, better effects are produced by giving free access of the water through the ports, and limiting its discharge at the moment or place of outflow sufficiently to keep the buckets constantly full. The wheel-case and the band or ring-gate *c* at the circumference of the wheel press the water against the buckets in its downward and outward course from its impact against the buckets till its discharge at the lower circumference of the wheel, thus utilizing the power of the water not only from its impact on the buckets at the ports, but its pressure during its whole flow through the wheel.

In giving the following description of the relative dimensions of one of my turbine wheels I do not wish to be understood as limiting my invention to the proportions of parts as set forth. There are six buckets in the wheel, each inclined downward opposite the direction of rotation, and being in length about one-third of the circumference of the wheel, and the whole of the front edge or end of the bucket is in the circumference of the wheel. The height and radius of the wheel are equal.

To illustrate further, I would make a twenty-inch wheel ten inches in height. The depth of the bucket from the circumference of the wheel at the radial line above mentioned would be five inches. There would be six ports, each five inches in height and about two inches wide. In such a wheel the area of the ports would be sixty inches, and the circumference of the wheel being more than sixty inches, it is obvious that if the ring-gate were raised an inch, or a little less, above the bridge-plate, the transverse area of inflow and outflow would be equal.

I claim as my invention—

1. A turbine water-wheel open to receive and discharge the water only at its periphery, which is formed with a series of inclined buckets each extending with a concave surface without an angle from its front edge at the periphery of the wheel back to the next following bucket and wholly facing outward, substantially as described.

2. A turbine water-wheel open to receive and discharge the water only at its periphery, and formed with concave buckets whose deepest part from the periphery for the whole length of each bucket is in an inclined straight line, and crosses the radius of the wheel at right angles, substantially as described.

3. A turbine water-wheel circular at the top and bottom and formed with a peripheral concavity of polyhedral form whose inclined and concaved sides extend forward and upward in the form of thin lips to the periphery of the wheel, and divide the concavity into inclined concave buckets wholly facing outward, and receiving and discharging the water only at the periphery of the wheel.

4. A turbine water-wheel having a concave periphery formed with a series of inclined concave buckets wholly facing outward and open only at the periphery of the wheel, the front edges of the buckets being curved, and the lower part of such edges inclined downward and backward, substantially as described.

5. A turbine wheel open to receive and discharge water only at its periphery, in combination with its case, and a ring-gate surrounding the wheel entirely below the ports for the entrance of the water, to regulate the lateral discharge of water, substantially as described.

6. The turbine wheel *a* and its case *b w*, in combination with bridge-plate *f* and ring-gate *c*, the latter being vertically movable to and from the bridge-plate, for the purpose of regulating the outward discharge of water between the gate and bridge-plate, substantially as described.

7. The wheel-case *b w*, provided with outwardly-diverging guides *b*, and shaped with a curved crown forming the top of the ports, the guides being curved inward at s^2 against the case, substantially as described.

8. The wheel-case formed in two sections, *b w*, bolted together, in combination with disk *e'*, bolted to the case and situated immediately over wheel *a*, and inclosing the upper compartment of the case from the lower, substantially as described.

9. A wheel-case formed with a lower compartment, *b*, containing wheel *a*, and an upper compartment, *w*, containing the lever *n'*, for operating the wheel-gate, the lever being connected and in combination with the wheel-gate by suitable intermediate mechanism, substantially as described.

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Witnesses:

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