2 Sheets—Sheet 1.

J. B. McCORMICK & J. L. BROWN.

TURBINE WATER-WHEEL.

No. 172,140. Patented Jan. 11, 1876.

Fig. 1

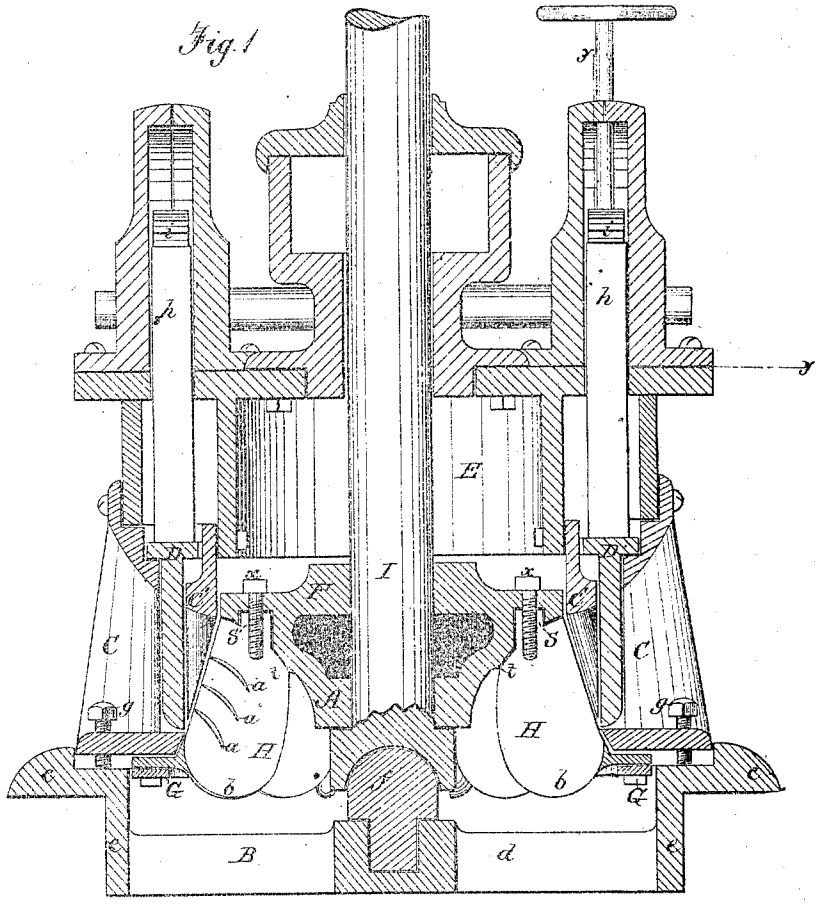
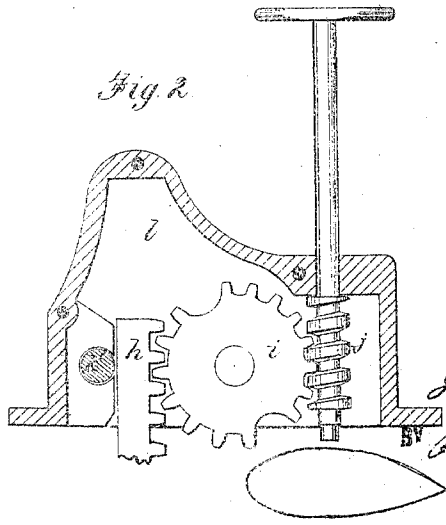


Fig. 2



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2 Sheets—Sheet 2.

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TURBINE WATER-WHEEL.

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Fig. 3.

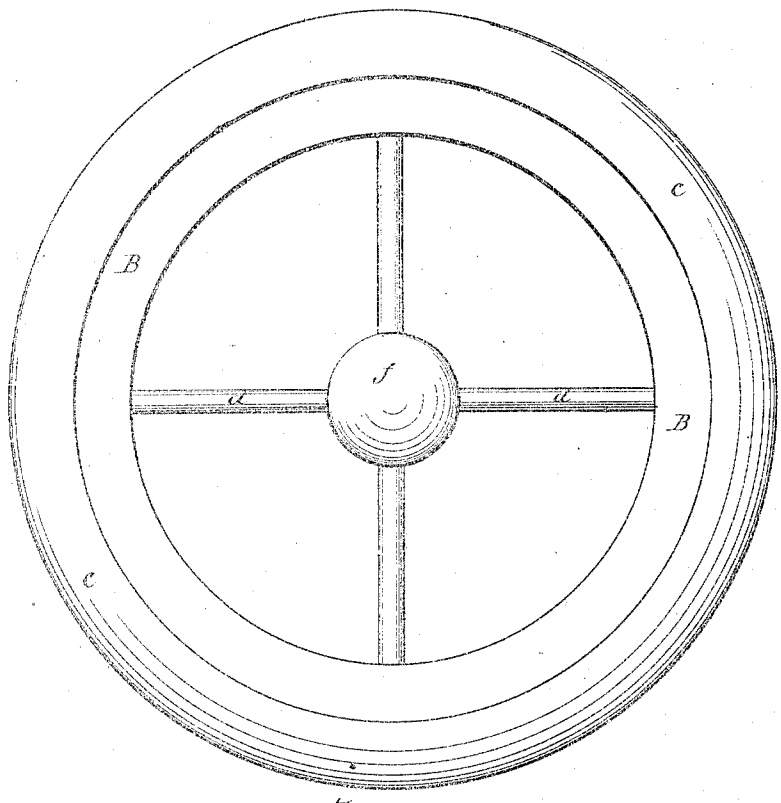
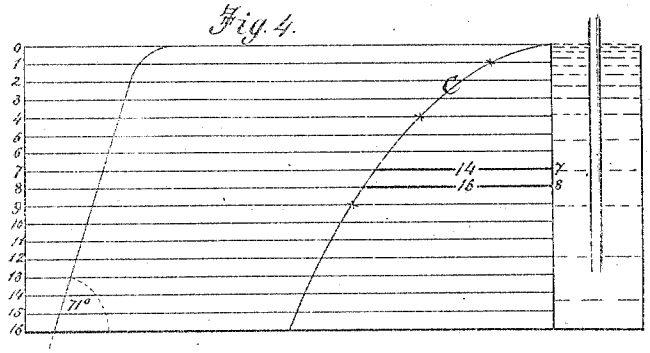


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN B. McCORMICK, OF ARMAGH, AND JAMES L. BROWN, OF BROOKVILLE, PENNSYLVANIA.

IMPROVEMENT IN TURBINE WATER-WHEELS.

Specification forming part of Letters Patent No. 172,140, dated January 11, 1876; application filed November 27, 1875.

CASE A.

To all whom it may concern:

Be it known that we, JOHN B. McCORMICK, of Armagh, in the county of Indiana and State of Pennsylvania, and JAMES L. BROWN, of Brookville, in the county of Jefferson and State of Pennsylvania, have invented a new and Improved Turbine Water-Wheel; and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing forming a part of this specification, in which—

Figure 1 is a vertical section; Fig. 2, a detail of the devices for adjusting the gate; Fig. 3, a plan view of the base; Fig. 4, a diagram illustrating the principle of the construction of the wheel.

This invention relates to certain improvements in that class of turbine water-wheels which receive their water from a vertical flume through lateral chutes, and discharge the same centrally through the bottom of the wheel.

The invention consists in the peculiar construction of the wheel and its co-operating parts, as hereinafter more fully described.

In the drawing, A represents the wheel; B, the base; C, the chutes; D, the gate or cut-off; and E, the upper frame or casing. The construction and principle governing the inclination of the wheel itself will first be described. F represents the top of the wheel of small diameter, and G the lower portion, of large diameter. H are the buckets, each of which is separate from the rest and fastened below to a rim by means of screws, and provided with a tenon, *s*, at the top, which passes into the top-plate F, and is secured by a bolt, *x*. The said buckets are set with the outer edges at an angle of seventy-one degrees, and are fitted to the underneath side of plate F, which is provided with a double curve, as shown at *t*, the upper part of which causes the water to lift the wheel and rotate it partly in suspension, and the lower part of which is designed to give greater clearance-room. These buckets are provided with wings *a*, which co-operate with the gate or cut-off, as hereinafter explained. Said buckets are so curved upon their inner surfaces as to cause them to receive the full impact of the water and yet allow it a perfect clearance or discharge inwardly, downwardly, and beneath the bottom of the wheel outwardly, the bottom part of the buckets at *b* being hollowed or bellied so that a part of the water is discharged outwardly beneath the wheel, the object being to provide as much extra clearance-room for the water as is ordinarily taken up by the central hub or shaft, whereby the discharge is the same as though the whole center of the wheel were unobstructed. The principle of the inclination of the wheel is dependent upon the different spouting velocities of water from columns of different heights. Now, the spouting velocity of water at its surface is zero, and the spouting of water at one foot from its surface is eight feet and a fraction per second, which velocity increases according to the squares of the head. Thus, if at one foot of head the velocity is eight feet, then at four feet of head it would be double, at nine feet it would be treble, &c. Referring to the diagram, the horizontal lines are lines upon which the velocities of the different heads of water are measured. The curved line *c* represents the different velocities, and the figures the different heads. Now, in order to ascertain the proper inclination of the wheel to produce the best result, the following illustration is given: We will suppose the wheel whose inclination is to be determined is one foot in height. If, now, the head of water is eight feet, and its spouting velocity at the bottom is sixteen feet in a second of time, the spouting velocity at the top of the wheel will be only fourteen feet in a second of time, or that of seven feet of head. Supposing the wheel to turn once in a second of time, its upper circumference will be fourteen and its lower circumference will be sixteen feet, which will make its upper diameter four feet eight inches and its lower diameter five feet four inches. Its upper radius will then be two feet four inches, and its lower radius two feet eight inches, which gives an inclination to the side of the wheel of about

seventy-one degrees. This inclination from the perpendicular is slightly greater, and the angle formed with the base correspondingly less as the head of water decreases, and as the head increases the angle increases and becomes more nearly a right angle. The variation, with practical working heads of water, will not, however, exceed twenty-five degrees. The object of thus regulating the inclination of the wheel according to certain mathematical formulas is to compensate for the different pressure and spouting velocity at the top and bottom of the wheel. As the velocity of water is less at the top of the wheel than at the bottom, it is obvious that if the top and bottom were of equal diameter, the wheel being impelled by the velocity at the bottom, would have a tendency to travel faster than the water at the top, which is obviated by constructing the radius of leverage of the top and bottom of the wheel in proportion to the different velocities at those points, thereby making the more-slowly moving water operate upon the more-slowly moving part of the wheel.

The object is also to secure the best effects of the head of water by making the sides of the wheel exactly at right angles, or as nearly so as practical to the discharge of the water, so as to receive the fullest impact therefrom.

We will now proceed to describe the other features of construction, which form a part of our invention. The base-piece B is constructed with a flange, *c*, bridge-tree, *d*, and rim *e*, all in one piece, with a central hole in the bridge-tree for the detachable wooden step *f*. The object of this construction is to simplify the arrangement of the wheel in the bottom of the flume. A hole is cut in the bottom of the flume, in which the rim *e* is placed, while the flange *c* extends over the edge, and supports the base and also the hollow end of the wheel-shaft I upon the step in such a manner that the wheel may be readily hoisted out and a new step substituted when desired. C are the chutes, which direct the water upon the wheel. Said chutes are connected above and below to rims, which form together a separate part of the wheel, which is supported upon the base B by means of set-screws *g*. The bottom part of these chutes co-operate with the wheel and the base to form a practically water-tight joint around the wheel to prevent the escape of water at the periphery, and as the step wears away the screws are loosened and the parts adjusted to said wear. C′ are a set of inside or hanging guides attached to the upper casing E, and projecting down into the annular space between the top of the tapering wheel and the chutes C. The object of these guides C′ is to carry the water close up to the wheel and prevent it from washing around the said annular space, which would be without effect upon the wheel. Between the guides C′ and the outside casing E is a cylindrical gate, D, which passes down between the said guides and chutes, and cuts off the water from the wheel. Said gate is operated by rack-bars *h*, pinions *i*, geared together by a shaft, and a worm, *j*, provided with a hand-wheel, the said pinion having one-half its periphery wrought into cogs and the other half into notches for the worm, the rack-bar being guided in the rear by a friction-roller, *k*, and the whole device contained in housings *l l*. The gate is made to rise instead of to lower, so as to let the water upon the lower and larger part of the wheel when a small quantity of water is to be used, whereby a greater leverage is secured and a greater velocity, in consequence of the deeper head. The wings *a* attached to the buckets of the wheel co-operate with the gate to control the impact of the water against the wheel when the gate is partially open. Thus, when the gate is raised one-fourth of the distance, the first set of wings compel the water to strike full against the buckets and prevent it from bursting up upon a portion of the wheel where the leverage is less, and when the gate is raised half-way the second series operate in the same way, and so on.

Having thus described our invention, what we claim as new is—

1. The combination, with gate D, of the buckets, having wings *a*, as and for the purpose described.

2. The combination of the chutes C, gate D, and the guides C′, substantially as and for the purpose described.

3. The combination, with the wheel A, of the base B, the chutes C, guides C′, the gate D, and the casing E, substantially as described.

4. The combination, with the rim G and top plate F, of the detachable buckets H, having tenons *s*, and fastened by bolts or screws, substantially as described.

5. The combination of the base B, chutes C, and adjusting-screws *g*, as and for the purpose set forth.

6. The top plate or hub F, having an extra clearance-curve at *t*, as and for the purpose described.

7. The buckets H, bellied at *b* so as to discharge a part of the water outwardly beneath the wheel, substantially as and for the purpose described.

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