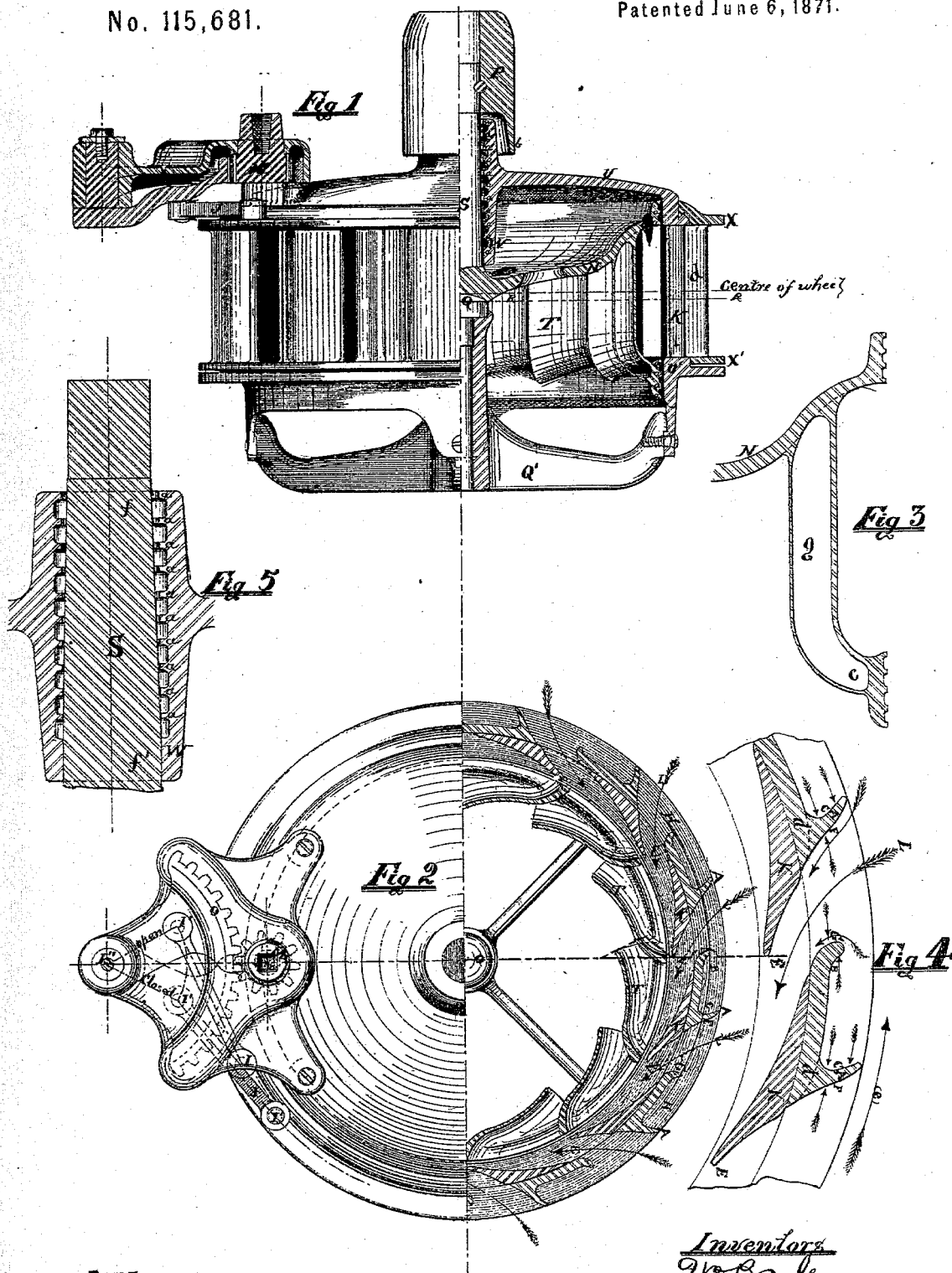


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Improvement in Water-Wheels.

No. 115,681.

Patented June 6, 1871.



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# UNITED STATES PATENT OFFICE.

WILLIAM BAYLEY AND ABNER B. CROWELL, OF WILMINGTON, DEL.

## IMPROVEMENT IN WATER-WHEELS.

Specification forming part of Letters Patent No. 115,681, dated June 6, 1871.

*To all whom it may concern:*

Be it known that we, WILLIAM BAYLEY and ABNER B. CROWELL, both of the city of Wilmington and county of New Castle, in the State of Delaware, have invented certain new and useful Improvements in Turbine Water-Wheels, of which the following is a specification:

The objects of our invention are: First, to provide an improved balanced gate for turbine water-wheels, by the use of which the power required to operate the gates will be materially reduced and the same rendered more susceptible to the action of a governor; and our improvement consists in a gate provided at its leading end with an inclined web or flange, placed in such relation to the main body of the gate that the action of the entering currents of water tends to hold the same in equilibrium, as hereinafter more fully set forth. Second, to provide improved means of preventing undue friction of the wheel upon the case in event of the latter settling upon one side; and our improvement consists in the combination of a turbine-wheel, shaft, and case so constructed as to provide a greater space around the shaft at its upper than at its lower end, as hereinafter set forth, whereby the wheel will be enabled to oscillate sufficient to accommodate itself to its step and to the case when the latter deviates from its normal position. Third, to provide improved means for reducing the friction of the water upon the backs of the buckets of a combined central and vertical discharge-wheel; and our improvement consists in so forming the buckets that the sectional areas of their throats shall be reduced as they recede from the center of the wheel—that is to say, in this instance, more at the bottoms than at the tops of the throats, thereby reducing the angles of the lower ends of the buckets with a horizontal line. Fourth, to provide improved means for preventing leakage of water between the shaft and case; and our improvement consists in combining, with the shaft of a turbine, and a sleeve projecting above the top of the case in which the shaft revolves, a coupling provided with a downward-projecting lip, between which and the sleeve packing can be inserted and maintained in position by the upward pressure of the water.

In the accompanying drawing, Figure 1 is a

side view, partly in elevation and partly in section, of our improved turbine; Fig. 2, a plan view, partly in elevation and partly in section, of the same; Fig. 3, a vertical section, on an enlarged scale, of a portion of the wheel; Fig. 4, a similar section of a portion of the gate; and Fig. 5, a similar section of a portion of the shaft and case.

The wheel N and shaft S are, in this instance, formed in one piece, which bears upon a step, Q, in a bridge-tree, Q', suitably secured to the lower portion of the wheel-case, which is composed of upper and lower sections U U', united by guide-columns K, the step being located at or near the vertical center line of the wheel. The gate is composed of the upper and lower rings X X', connected by plates d, so arranged that when rotated in the direction of arrow e the plates d can be made to wholly or partially close the spaces between the guide-columns K, thereby stopping or diminishing the flow of water to the wheel, which flow takes place in the direction of the arrows L.

As heretofore constructed the leading ends of gates have been made as indicated by the dotted lines in Fig. 4, in which case experience has demonstrated that the water will press against the surface B in the direction of the arrow, having a tendency to close the gate with a pressure nearly equal to that due to the head of water under which the wheel is working, because the water is comparatively still at B and in rapid motion at G, and where the motion is greatest the side pressure is least.

To counterbalance this pressure we provide our gates at their leading ends with inclined ribs or flanges A, Figs. 2 and 4, placed at such an angle as to properly direct the currents of water to the spaces between the guide-columns K. The pressure against the surface B is counterbalanced by a corresponding length of the surface C, and as the pressure against the surface C is in excess of the pressure against the surface F, by reason of the water being in more rapid motion past the surface F, the pressure against the remainder of the surface C counterbalances the pressure against the whole surface F. In order to obviate any injurious results from the settling of the wheel-case, such as throwing the wheel and shaft out of line and causing an undue and injurious friction of the wheel and shaft upon the case,

the shaft S is made tapering, from its lower to its upper portion, so as to leave a greater space at its upper than at its lower end, between it and the sleeve, or portion of the case which surrounds it, Figs. 1 and 5.

In practice we make the shaft fit neatly within the case at its lower end, and the amount of clearance given at the upper end varies, according to the diameter of wheel and length of shaft, at the discretion of the constructor. It is obvious that this end may be accomplished by using a shaft of uniform diameter throughout the length of the sleeve, and boring out the sleeve so that its diameter shall be greater at the top than at the bottom; or a shoulder or shoulders may be formed upon the shaft for the same purpose. By this construction the wheel is at liberty to oscillate, through a limited range of motion upon the step Q, and thereby accommodate itself to the unequal settling of the case without the injurious results hereinbefore stated. Referring to Figs. 1 and 3, it will be seen that we construct our buckets T T in such manner that the area of their throats is diminished as they recede from the center of the wheel. In the construction herein shown the lower ends of the buckets are furthest from the center of the wheel, and consequently the sectional area of the portion *c* of the throat is less than that of the portion *g*; but our improvement would be likewise applicable if the upper ends of the buckets were furthest from the center of the wheel.

In Letters Patent of the United States granted and issued to us March 22, 1870, we have described and claimed buckets the sectional area of whose throats increase toward their discharging or tail ends, and it is obvious that this branch of our invention is equally applicable to buckets so constructed, or to those of uniform sectional area of the throat. By this

construction we reduce the angle formed by the lower ends of the buckets with a horizontal line, and thereby reduce the angle of the buckets at the point where they move fastest, namely, at the point furthest from the center, and correspondingly reduce the resistance to the discharge of the water.

Referring to Fig. 1, it will be seen that we construct the coupling P with a lip, *b*, projecting downward and around the upper portion of the sleeve W, but separated from it far enough to allow of the introduction of packing between their surfaces, and entirely prevent leakage around the shaft.

The method of operating the gates and of connecting the wheel to the machinery to be driven not being the subject of the improvements herein claimed, need not be here described.

What we claim as our invention, and desire to secure by Letters Patent of the United States, is—

1. A gate for a turbine water-wheel, provided with webs or flanges A and B, the webs A being extended further from the line of contact with the case than the web B, substantially as described, and for the purpose set forth.

2. The combination of a turbine water-wheel, a shaft, and a case, so constructed as to afford greater space or clearance between the shaft and case at the upper than at the lower end, substantially as and for the purpose set forth.

3. The combination of the shaft S, the case U, and the coupling P, provided with a downward-projecting lip, *b*, substantially as and for the purpose set forth.

WILLIAM BAYLEY.  
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Witnesses:

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