(No Model.)

2 Sheets—Sheet 1.

C. LE DUC.

WATER WHEEL.

No. 423,935. Patented Mar. 25, 1890.

Fig. 1.

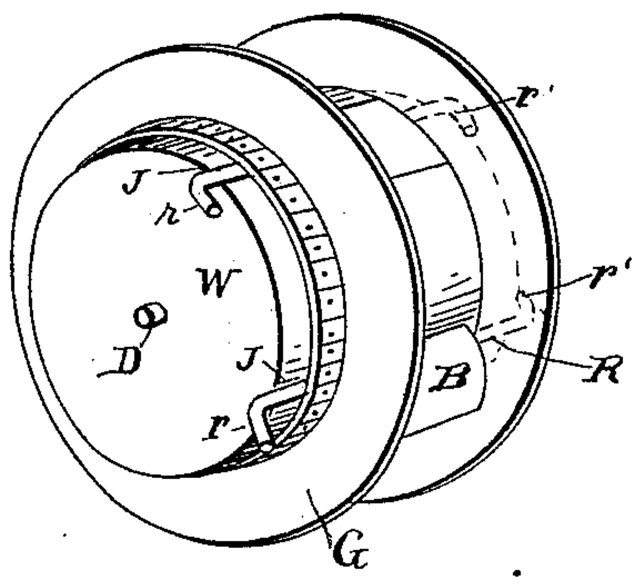


Fig. 3.

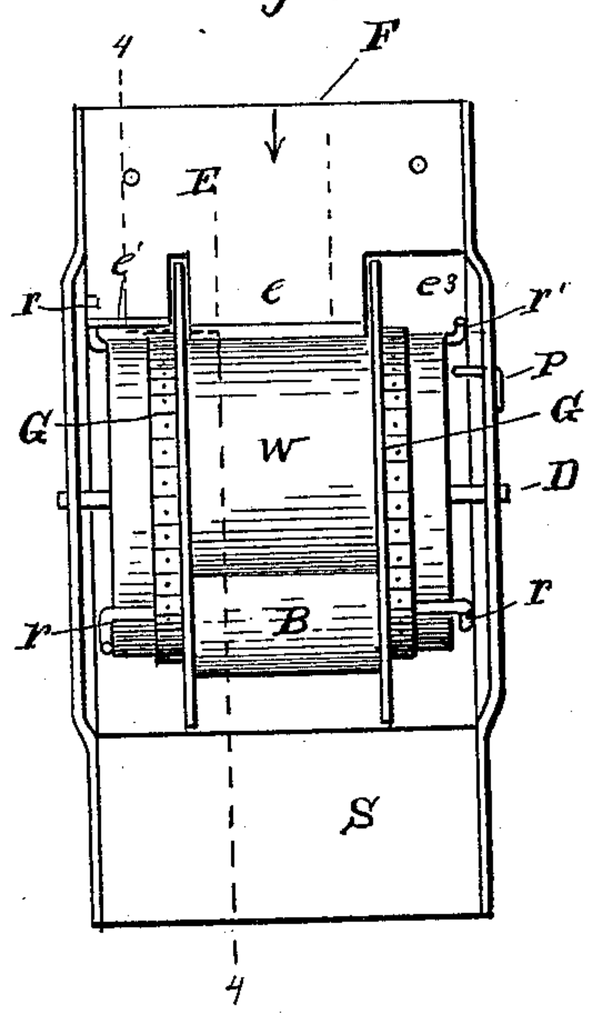


Fig. 4.

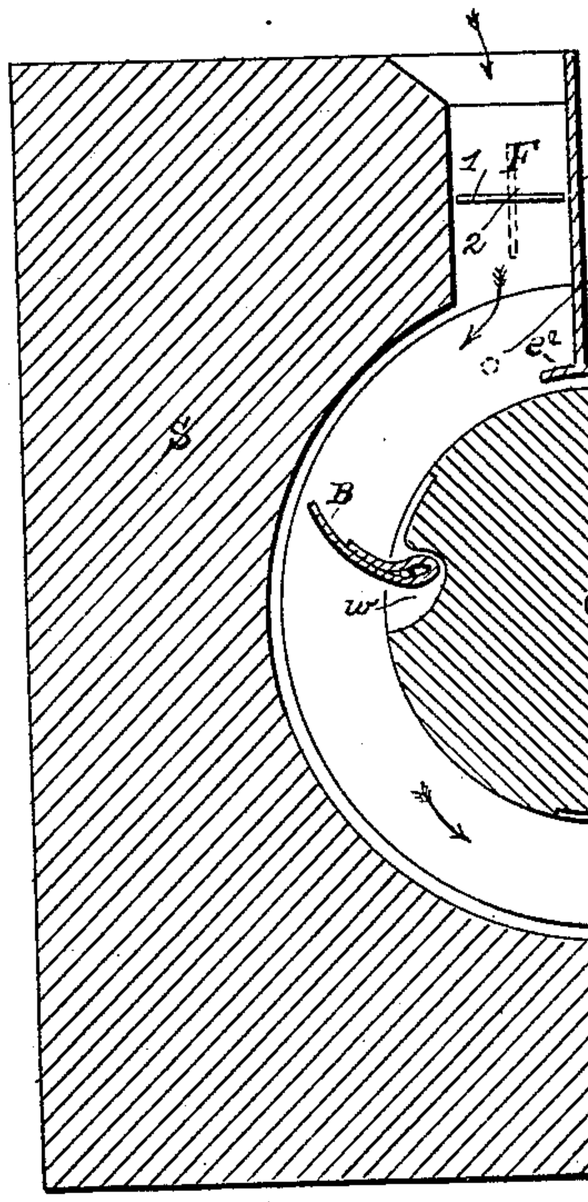


Fig. 8.

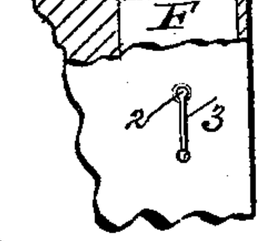
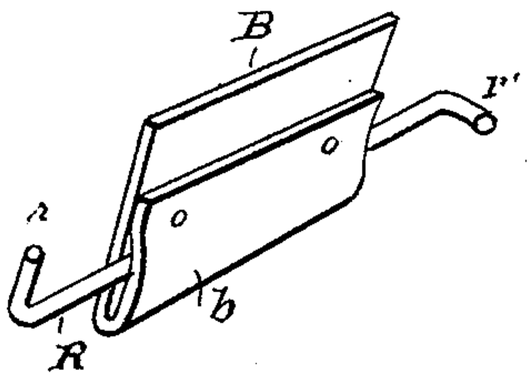


Fig. 2.



Attest.
Victor J. Evans.
N. L. Gollamer

Inventor.
Charles Le Duc
by Geo. H. Schneider & Co
Attorneys.

(No Model.) 2 Sheets—Sheet 2.

C. LE DUC.

WATER WHEEL.

No. 423,935. Patented Mar. 25, 1890.

Fig. 5.

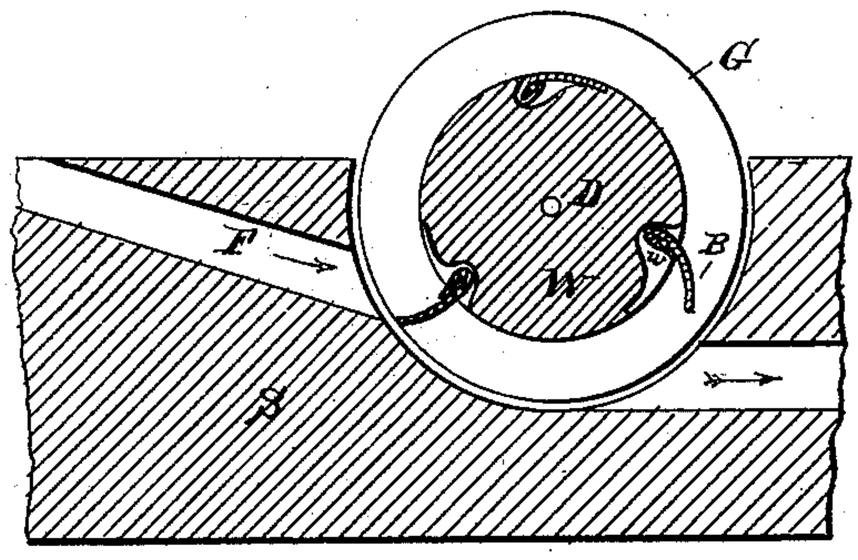


Fig. 6.

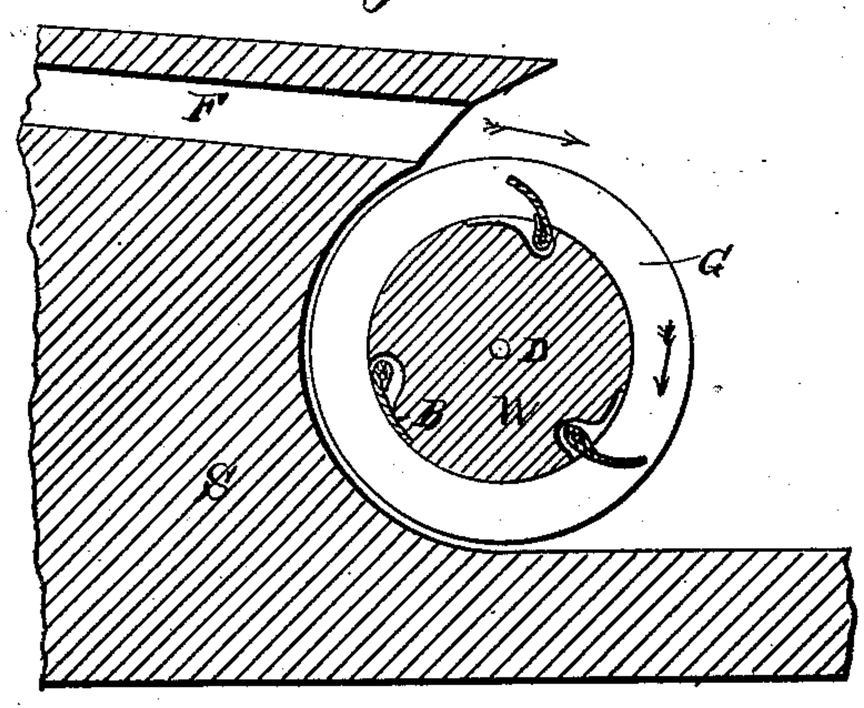
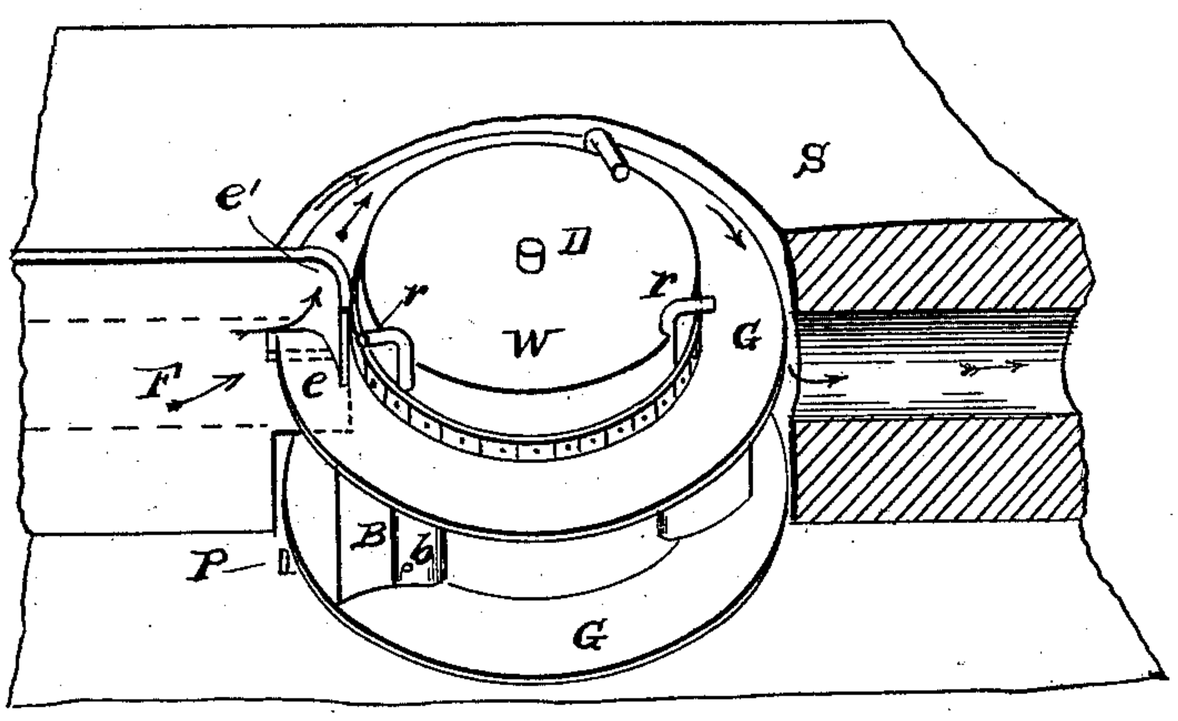


Fig. 7.



Attest.
Victor J. Evans.
N. L. Collamer

Inventor.
Charles Le Duc
by Munn Schroeder & Co
Attorneys

UNITED STATES PATENT OFFICE.

CHARLES LE DUC, OF CRESCENT, WASHINGTON.

WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 423,935, dated March 25, 1890.

Application filed March 27, 1889. Serial No. 304,984. (No model.)

To all whom it may concern:

Be it known that I, CHARLES LE DUC, a citizen of the United States, residing at Crescent, in the county of Lincoln and Territory of Washington, have invented certain new and useful Improvements in Water-Wheels; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to water-wheels, preferably of that class known as "breast," wherein is employed positive mechanical means for throwing the buckets into and out of operative position, all as fully described and claimed herein.

The accompanying drawings (wherein the same letters of reference have been applied to similar parts throughout) illustrate, and this specification fully and accurately explains, what I believe to be the best manner of carrying out my invention.

In the said drawings, Figure 1 is a perspective view of my improved water-wheel detached from its supporting-frame. Fig. 2 is a perspective detail of one of the buckets of said wheel. Fig. 3 is a front elevation of the supporting-frame, said figure illustrating the mechanical devices for effecting the positive movements of the buckets. Fig. 4 is a central vertical section, as on line 4 4 of Fig. 3, showing my improved wheel arranged within the supporting-frame as a breast wheel. Fig. 5 is a similar view showing it arranged as an "undershot" wheel. Fig. 6 is a similar view showing it arranged as an "overshot" wheel. Fig. 7 is a perspective view, partly broken away, showing it arranged as a turbine wheel; and Fig. 8, a detail showing the flume-gate.

In water-wheels as heretofore constructed there has been a considerable loss of power, which experts have labored, with more or less success, to obviate. The primitive form of water-wheel was made with buckets which consisted of boards secured upon the periphery of the wheel and extending radially from its center, and this form was followed by that having curved or V-shaped buckets, the latter being in very extensive use at present and the former being now almost extinct. When employed upon a breast wheel, these V-shaped buckets receive the water as delivered from the flume at a point a few degrees past the top of the wheel, convey it downwardly by the horizontal center of the wheel, and discharge it below. In an overshot wheel the action is substantially the same, except that the buckets are inverted, the water flows over the wheel instead of under it, and the latter revolves in the opposite direction. In an undershot wheel the V-shaped buckets are not so generally employed.

The existing objection to the use of the V-shaped bucket upon water-wheels is this, that in overshot and breast wheels the buckets at the point where they receive the water are so inclined that they are not filled, whereas before they have reached the point where it is desired to discharge the water their inclined sides have permitted a discharge of a considerable portion thereof gradually, thus wasting power at both ends of their travel. A further objection is that these buckets, or, in fact, any stationary buckets heretofore made, are operative throughout but about one hundred and twenty degrees of the circle they describe.

The objection to the use of a plane or V-shaped bucket upon undershot wheels is that the buckets are very much inclined where they first strike the water and where they finally leave it, and hence are really effective only at and very near on either side of the bottom point of the wheel, throughout probably about sixty degrees of the circle of the entire wheel.

The letter F designates the flume within the supporting-frame S, through which the water is supplied to drive the wheel.

The letter W designates the wheel; G, flanges or guides thereon; B, the buckets; R, the rods upon which said buckets are carried; P, the pin or other device for operating the buckets, and D the main shaft of the water-wheel, from which the machinery is driven.

My improved wheel comprises a cylindrical body W, which may either be solid or hollow, as preferred, and upon the periphery thereof

are located two parallel annular flanges or guides G, located, respectively, near the ends of the body. Within the said body, at suitable points in its periphery, are cut recesses *w*, extending from one guide to the other, and from either end of each recess a journal J leads outwardly to the opposite ends of the wheel. The buckets B are preferably curved in the arc of a circle of the same size as the periphery of the body W of the wheel, and near one of their edges are rigidly secured to the outer sides of rods R, the latter being led through the journals J, and provided with cranked ends *r r'*, which stand beyond the ends of the body W. The attachment of the buckets B to the rods R is such that the former may lie flush with the outer face of the body, or may turn in their journals, so as to stand in radial lines from the center of the wheel. In the latter position their narrow edges *b* sink into the recesses *w* and abut against shoulders *w'* therein, thereby rigidly supporting the buckets in this position against the force of the water. In length the buckets are just sufficient to fit closely, yet without being in contact between the inner faces of the guides G.

At the point on the wheel to which the force of the water is directed the flume F is led thereto in a manner well understood. This flume is preferably open on its front face, and a shield E is removably secured over the open portion thereof, by which it will be normally closed, or may be inspected at will. The shield E has a tongue *e* of a breadth just sufficient to fit closely, yet without friction, between the guides G, and of a length sufficient to extend to a point in close proximity to the face of the body W. At one side the shield E is also provided with a projection *e'* outside the guide G, at that end of the wheel which is adapted to be engaged by one of the cranked ends *r* of the rods R, for a purpose hereinafter to be described, while at its other side the shield E is cut away, as shown at *e'*.

The frame S must of course be adapted in shape to the style of water-wheel employed, whether breast or overshot, as illustrated in the several views of the drawings, and the flume F must of course be led to such a point that the water will be properly directed so as to exert its force in the manner desired upon the buckets of the wheel. All this will be clearly understood by a person skilled in the art, and I therefore do not consider it necessary to give a more specific description of the devices illustrated in Figs. 4, 5, and 6.

My improved water-wheel having been constructed as described and suitably mounted in its supporting-frame, the operation will be as follows: The water flowing through flume F will strike a bucket upon the descending side of the wheel and its force will revolve the wheel, carrying said bucket with it to a point where the force of the water is of no further avail. The wheel continuing to revolve, the bucket will then rise on the other side thereof, close by its own weight, pass under the tongue *e* in closed position, and open automatically to receive its next charge of water. If, however, any bucket should fail to close automatically before reaching the tongue *e*, the cranked end of its supporting-rod R will strike the projection *e'*, which is slightly in advance of the tongue *e*, whereby the bucket will be positively closed before it reaches said tongue. The projection *e'* has a T-shaped end *e''*, beneath which the crank *r* slides while the bucket is passing under the tongue *e*, by which means said bucket is prevented from rising even partially and accidentally striking the tongue. If any bucket should fail to open automatically after it has passed the tongue *e* and come under the flume F, the cranked end *r'* at the other extremity of its supporting-rod R will strike a pin or other device P, carried in the frame S and located at a suitable point.

It will be understood that the cranks *r* and *r'* are "quartering" upon the rods R—that is to say, that lettered *r* lies in a plane with the bucket, and while the latter lies flat upon the face of the wheel this crank lies also flat and is passing under the T-shaped head *e''* of the projection *e'*, while at the same time the other crank *r'* extends inwardly from the line of the rod R directly toward the center of the wheel. It will also be understood that the T-shaped head *e''* is just of sufficient length so that the end of the crank *r* will pass out from under it at the instant before the crank *r'* strikes the pin P.

My improved water-wheel and connections may be used as one species of a turbine wheel, as illustrated in Fig. 7. In this instance the arrangement of parts is substantially the same as when it is otherwise used, excepting, of course, that the main shaft D is vertical, or approximately so, and the wheel rotates in a horizontal plane.

I have shown in detail in Fig. 8 a gate which I use in the flume. It consists of a single piece 1, of any desired material, rigidly secured at its center to a shaft 2, said shaft having bearings in the sides of the flume and provided at one end with a crank-arm 3. When the water is to be kept from the wheel, this gate is turned to the position shown in full lines in such figure, the dotted lines showing it opened. By having the gate secured at its center to its operating-shaft I find it much easier to operate and more effective, as the heft of the water always bears evenly against all parts of it.

I am aware that water-wheels have heretofore been provided with two stops arranged to effect the positive opening and closing of the buckets, the arrangement being such that the stops referred to strike against the buckets proper, and I am also aware that a wheel has also been heretofore provided with rods provided with crank-arms, one of which has

been arranged to be operated by a single stop, and I therefore do not claim such constructions; but

What I claim as new is—

1. In a water-wheel, the combination, with a cylindrical body, rods journaled in the periphery of said body, said rods being provided at each end with a crank, the two being arranged at opposite angles to each other, buckets rigidly secured upon said rods, and a suitable supporting-frame, of stops arranged upon said frame in such a manner that one stop will strike one crank of the rod, and thereby close the bucket secured to such rod, and at a suitable time thereafter the remaining crank-arm will strike the remaining stop and open the bucket, as and for the purpose set forth.

2. The wheel W, having recesses *w* in its periphery, the rods R, journaled in said periphery at the ends of said recesses, said rods having cranked ends *r* and *r'*, whose cranks lie at approximate right angles to each other, and the buckets B, rigidly secured upon said rods between their ends, in combination with the frame S, in which said wheel is journaled, the flume F in said frame, the shield E, secured removably over the open face of said flume, the projection *e'* on said shield having a T-shaped head *e''*, adapted to strike one of said cranks *r* to close the bucket before it reaches the flume, for the purpose described, and the pin P in said frame adapted to strike the other of said cranks *r'* to open said bucket directly under the flume, the whole operating substantially as and for the uses and purposes hereinbefore described.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES LE DUC.

Witnesses:

GEORGE W. ODELL,

J. P. EDWARDS.